NOVEMBER · 1949

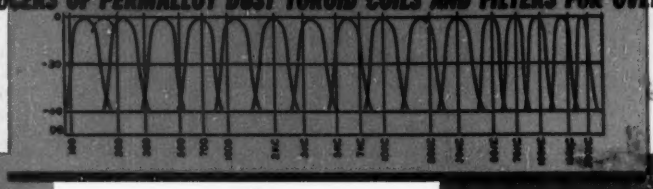
electronics

A McGRAW-HILL PUBLICATION

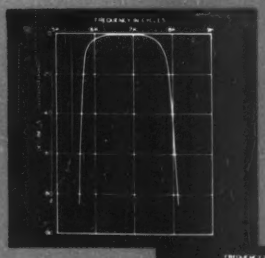
MODERN MAGNETRON CONSTRUCTION

FILTER SPECIALISTS

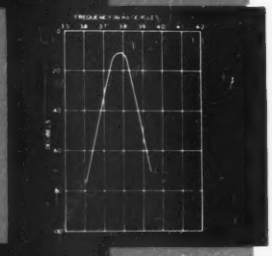
PRODUCERS OF PERMALLOY DUST TOROID COILS AND FILTERS FOR OVER A DECADE



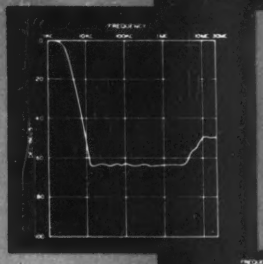
FOR FILTERS



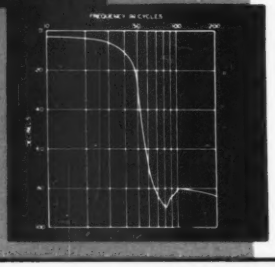
BROAD BAND SHARP CUTOFF FILTER



NARROW BAND SHARP CUTOFF FILTER



ATTENUATES 10KC TO 30 MEGACYCLES

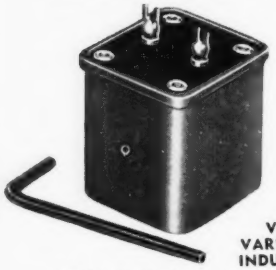


LOW FREQUENCY — LOW PASS FILTER

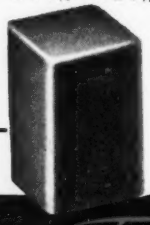
HQA, C, D TOROID COILS
1 1/16" Dia. x 1 1/16" High.

HQB TOROID COIL
2 5/8" L. x 1 5/8" W. x 2 1/2" H.

UNCASED TOROIDS



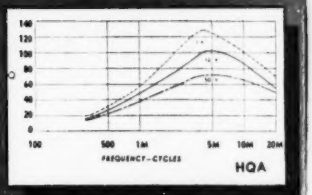
VIC VARIABLE INDUCTOR
1 3/8" L. x 1 1/4" W. x 1 1/2" H.

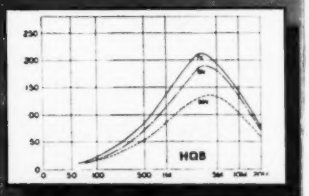


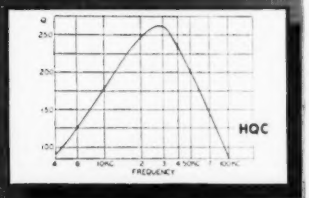
SUB-OUNCER TOROID FILTERS

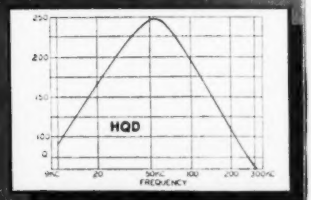
Filters employing SUB-OUNCER toroids and special condensers represent the optimum in miniaturized filter performance. The band pass filter shown weighs 6 ounces.

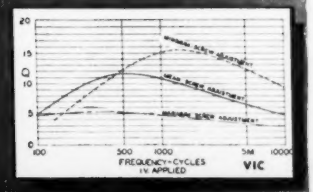
FOR HIGH Q COILS











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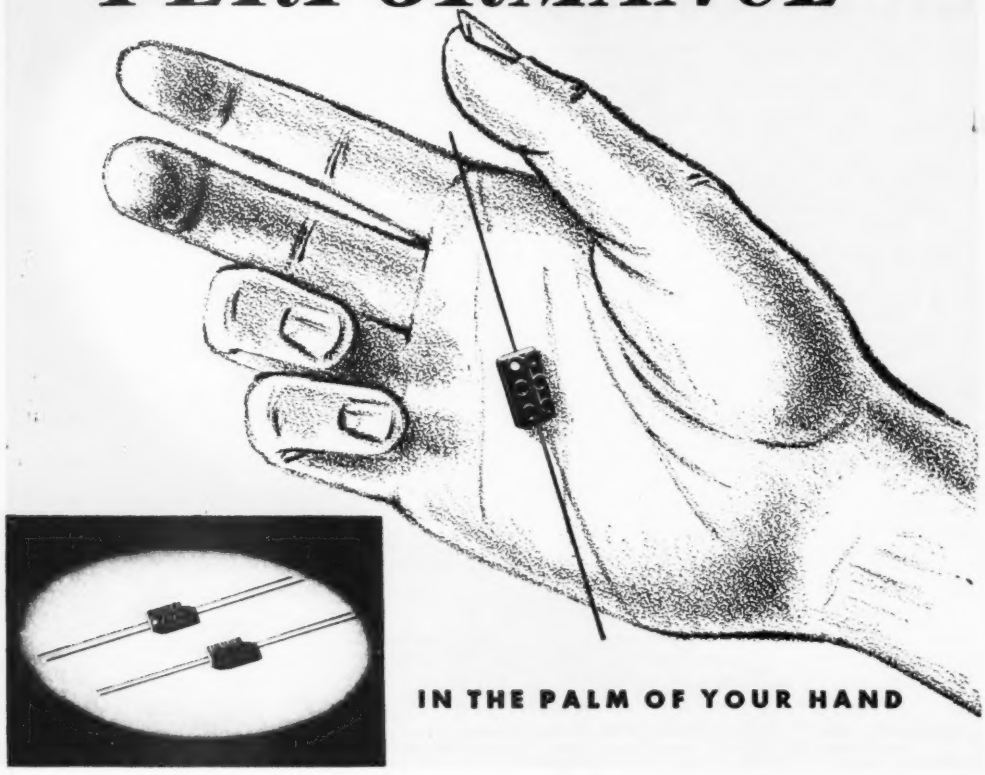

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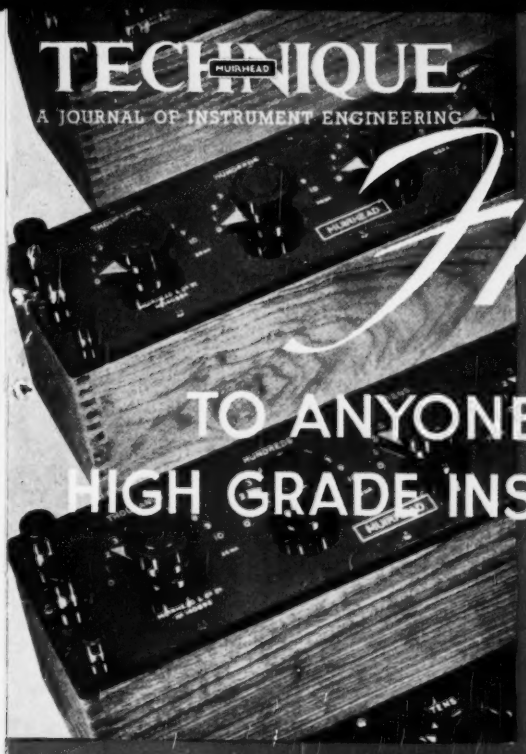

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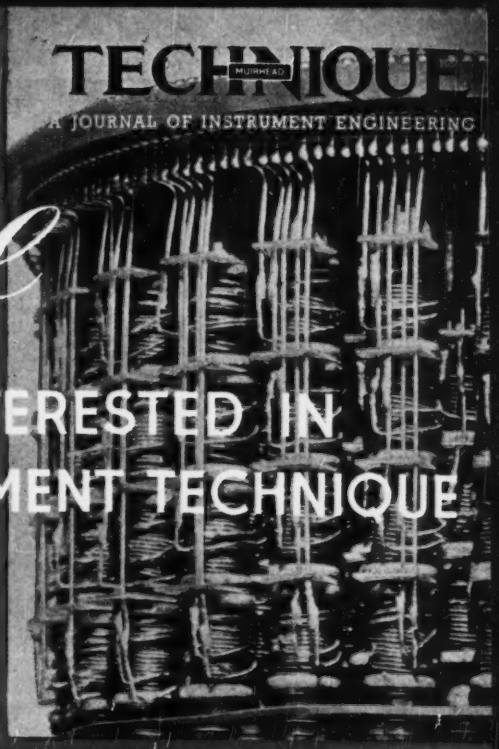

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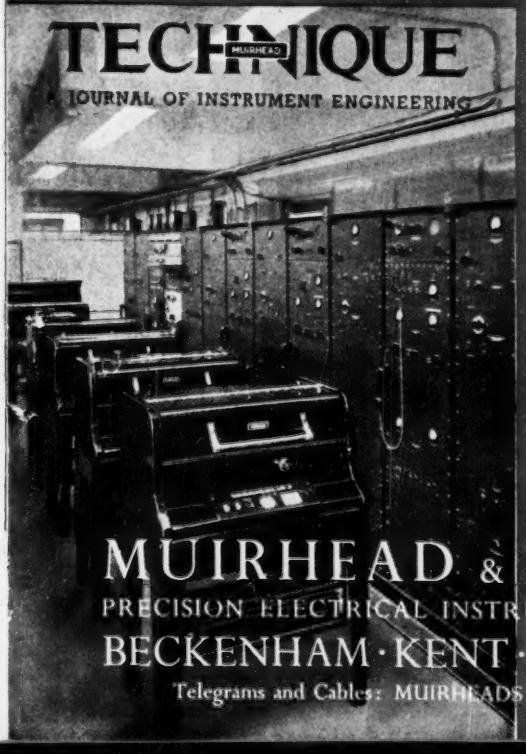

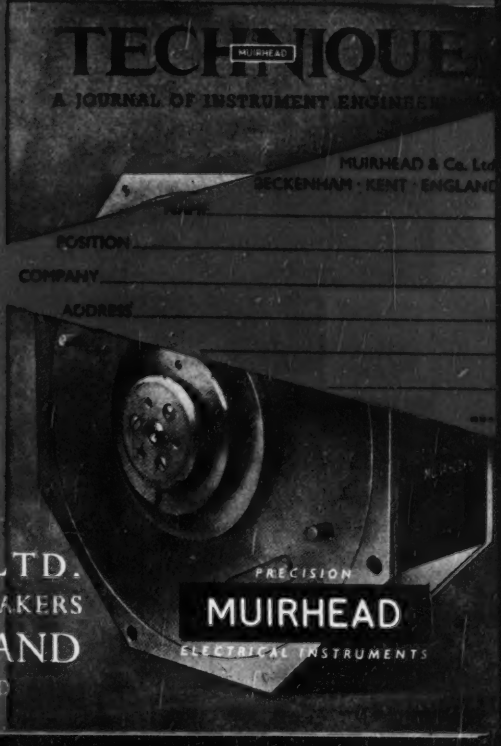

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Microphones	Loudspeakers
633 Type	728B
639 Type	755
	757

Reproducing Equipment

109 Type Reproducer Group
9A Reproducers
9B Reproducers

To assure uninterrupted service and maintenance to owners of these products, we have entered into an agreement, effective Oct. 1, 1949, with the ALTEC LANSING CORPORATION of Hollywood, California. Under the terms of this agreement the Altec Lansing Corporation receives all necessary engineering information, as well as our inventory of the above equipments and their parts, and will make available service, maintenance, repair and replacement parts for the products listed.

The Graybar Electric Company will act as distributor for the Altec Lansing Corporation, as it has for Western Electric, in serving customers' needs on these equipments, under terms of an agreement recently concluded between the Graybar Electric Company and the Altec Lansing Corporation.

The leadership and integrity of the Altec Lansing Corporation make us completely confident that all users of the Western Electric equipments listed will continue to have available to them service of the very highest quality.

F. R. Lack
Vice President

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(1) BH "649" retains rated dielectric strength even after rough handling and severe bending;

(2) BH "649" stays supple after baking 12 hours at 300°F;

(3) No flowing, softening or blistering after 15 minutes at 425°F.

Reports of savings are common because BH "649" sells at a price comparable to ordinary cotton-base or rayon-base insulations. With BH "649" a less expensive grade of insulation can often be used since there is little or no loss of dielectric strength in assembly or product use.

BH "649" is made in Grades A-1, B-1, C-1 and C-2—in all sizes from No. 24 to ⅜" inclusive. If you haven't tried BH "649" let us send you samples.

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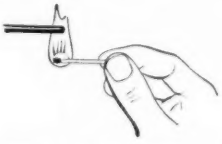
KNOT IT . . . Take a length of BH "649". Knot it. Pull it as tight as you can. Twist it. Then loosen the knot. There is no cracking. No change in the dielectric strength.

RUB IT . . . Take a length of BH "649". Hold the ends firmly. Then rub the sample up and down briskly in a sawing motion against the edge of a desk or chair. See how difficult it is to damage the coating.



HOLD A MATCH UNDER IT . . . Take a length of BH "649". Hold a lighted match under it. BH "649" will not support combustion.

BH Fiberglas* SLEEVINGS

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I am interested in BH "649" Fiberglas Tubing and Sleeving. Send samples for production testing of Grade_____ in sizes as follows_____ (size or I.D.) for_____ (product) operating at temperatures of_____°F. at_____volts.

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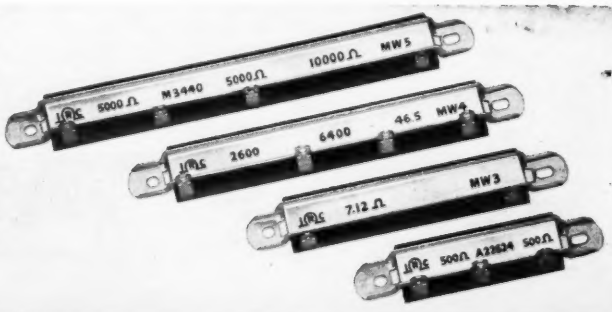
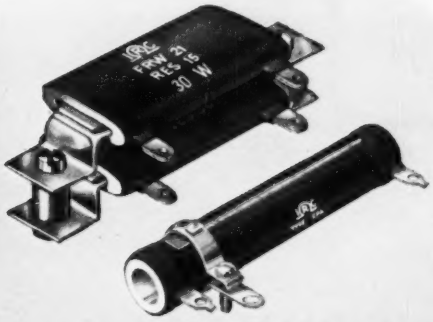
UNSURPASSED FOR ADAPTABILITY to an extremely wide variety of design requirements, IRC Type MW Wire Wound Resistors also give more watts per dollar than conventional types. Initial cost and mounting cost are low. Flexibility in providing taps and savings in space suit flat Type MW's to a host of difficult applications. Mounting bracket of unique design actually transfers heat from inside resistor to mounting surface. MW's may be operated at full "on plate" rating, whether enclosed or not, without exceeding their rated temperature of 100° C. (Thus, an MW 5 can be used at 20 watts where a 60 watt tubular resistor would normally be required.) Use the convenient coupon to obtain full characteristic and specification data.



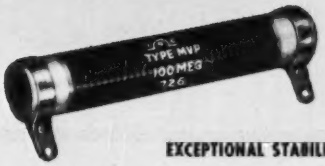
be tough



HIGHER SPACE-POWER RATIO than tubular power resistors makes IRC Type FRW Flat WireWounds ideal for voltage dropping applications in limited space. FRW's can be mounted vertically or horizontally, singly or in stacks—and are available in fixed or adjustable types. Bulletin C-1 gives all the performance facts.

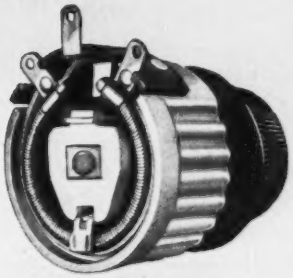
UNEXCELLED IN EXACTING, HEAVY-DUTY REQUIREMENTS, IRC Power Wire Wounds are designed to give balanced performance in every characteristic. Special dark, rough coating assures ability to combat humidity and moisture corrosion, dissipate high heat rapidly, withstand reasonable overloads without opens or breakdowns. Available in a broad range of ratings, sizes and terminal styles in fixed and adjustable types. Send for Bulletin C-2.

When you're being "powered" for fast service on small order resistor requirements for experimental work, pilot runs, or maintenance, call your nearest IRC Distributor. IRC's Industrial Service Plan enables him to save you time and worry by giving you 'round-the-corner service on standard types right from his local stocks. He's a handy man to know. May we send you his name and address?



EXCEPTIONAL STABILITY even in very high resistance values assures the dependability of IRC Type MV Resistors in high voltage applications. Unique application of IRC's famous filament coating in helical turns on a ceramic tube provides a conducting path of long effective length, and permits the use of high voltage on the resistor while keeping the voltage per unit length of path comparatively low. Bulletin G-1 gives complete characteristics; use handy coupon.

LENGTH OF RESISTANCE PATH IN INCHES—FOR MV TYPES			
MVF	10	MVS	20
MVG	25	MVT	30
MVJ	50	MVB	70
MVP	80	MVD	95
MVA	190	MVZ	185
MVO	330	MVE	265
MVR	1,100		



VARIABLE POWER requirements within 25 and 50 watt ratings are well handled by IRC Type PR Power Rheostats. All-metal corrugated construction gives maximum heat dissipation. PR Rheostats can be operated at full power in as little as 25% of rotation without appreciable temperature rise. Direct contact between housing and mounting panel increases ability to disperse heat. Bulletin E-2 details specifications; send for your copy.

IRC — *Wherever the Circuit Says* ~~~

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- ☐ MV High Voltage Resistors
- ☐ PR Power Rheostats
- ☐ FRW Flat Wire Wounds
- ☐ Power Wire Wounds
- ☐ Name and address of local IRC Distributor

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Many users of plastics enjoy Richardson's VARIETY of products and services. They like the convenience of handing all of their plastics problems to one organization. More important, they like for Richardson to assume complete responsibility for their plastics requirements.

Such an arrangement is possible with Richardson because here, from one company, you can get (1) Laminated INSUROK in a wide variety of grades suitable for virtually every plastic laminate requirement (2) complete punching facilities (3) complete fabricating facilities (4) complete molding facilities (5) experienced engineering (6) complete laboratory facilities if your job calls for laboratory research (7) mold and die design and facilities to produce molds and dies and (8) conscientious, personal attention to your particular needs.

Why not see what this variety of products and services can do for you? Send a set of specifications today and learn, without obligation, how Richardson would approach your job . . . find out for yourself how Richardson's "undivided responsibility" can work to your advantage.

INSUROK is a registered trade-mark of The Richardson Company

The RICHARDSON COMPANY

GENERAL OFFICES: LOCKLAND, OHIO FOUNDED IN 1858

Sales Headquarters: MELROSE PARK, ILLINOIS

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ADVENTURES IN ELECTRONIC DESIGN

Centralab's Great New Model 2 Radiohm*

14 Good Reasons Why CRL'S Model 2 Radiohm is the Control for You!

1. *Switch* — with positive detent in both on and off positions. *Terminals* — with surfaces elevated to eliminate danger of shorting to cover legs . . . ¼" hole diameter for simplified wiring . . . hot tin dipped for easy soldering . . . mechanical lock to prevent loosening in soldering operations.

2. Cadmium plated steel *cover* completely shields resistor.

3. *Insulator's* high dielectric strength permits breakdown test at 1000 volts R. M. S. Dust and dirt can't get in.

4. *Stop*, of cup design, provides superior switch shielding . . . gives you excellent torque strength without distortion.

5. High grade laminated phenolic *shoe* maintains high insulation resistance under humidity conditions.

6. Contact Spring gives you double wiping contacts on both resistor and center terminal ring . . . is accurately formed to maintain uniform pressures and minimize noise.

7. Electro tin-plated *terminals* provide soldering ease. Tightly crimped terminals give you direct contact to resistor . . . assure constant contact under humidity and soldering conditions.

8. *Resistor* is made of special resistance material bonded to high quality phenolic for smooth operation, low noise level, outstanding humidity characteristics.

9. Cadmium-tipped *center terminal* provides easy soldering . . . good shelf life without oxidation. Adequately lubricated for good rotation life, center terminal is finished to give you smooth take-off . . . minimum noise.

10. Laminated phenolic *base* maintains high insulation resistance under humidity conditions.

11. Cadmium-plated steel *ground plate* assures positive grounded cover.

12. Cadmium-plated steel *bushing* is accurately finished and fit to shaft for smooth rotation.

13. *Retaining ring.*

14. *Shafts.* Unlimited variations available to meet your specifications.

*Switch Type, Tapped. **Exploded View:** Switch Type, Untapped.*

Centralab — DEVELOPMENTS THAT CAN HELP YOU

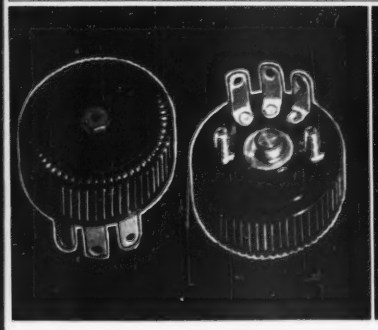
Division of GLOBE-UNION INC. • Milwaukee

Centralab reports to

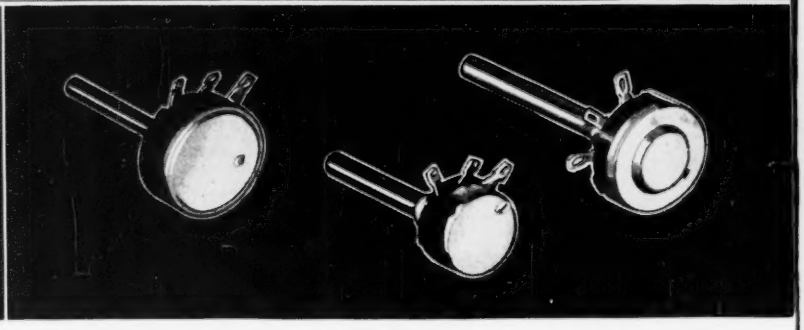
NOVEMBER, 1949

Small Size makes Model 2 Radiohm the Right Control for many different uses!

IMAGINE the large variety of uses for peak-quality controls that are only 15/16" in diameter, yet rated at 1/2 watt. That's Centralab's great new line of Model 2 Radiohms. Designed for television and radio sets, sound and test equipment, the versatile Model 2 is just what you need for many other electronic uses where a combination of small size and finest performance is essential. CRL Model 2 Controls are precision built of the finest materials to give you lower noise level . . . longer life. Their clinched terminals insure rigid contact to the resistance element under humidity and soldering conditions. What's more, Model 2's complete line of 3 basic switches — 5, 8, and 1 amp. — provide 24 switch combinations for real flexibility in application and design. For all the facts, see your CRL representative or write direct.

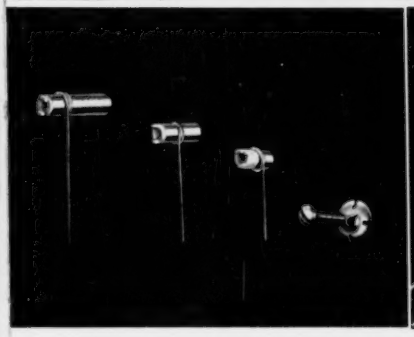


1 Model "1" *Radiohm* control, rated 1/10 watt — plain and switch types. No larger than a dime. Designed for miniature uses.

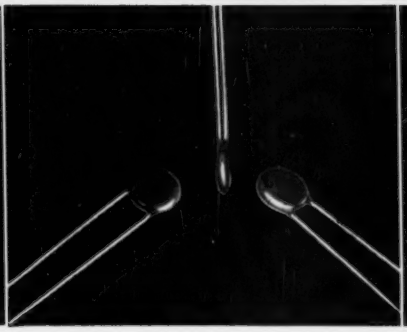


2 Let Centralab's complete *Radiohm* line take care of your special needs. Wide range of variations: *Model "R"* — wire wound, 3 watts; or composition type, 1 watt. Model "E" — composition type, 1/4 watt. Direct contact, 6 resistance tapers. *Model "M"* — composition type, 1/2 watt.

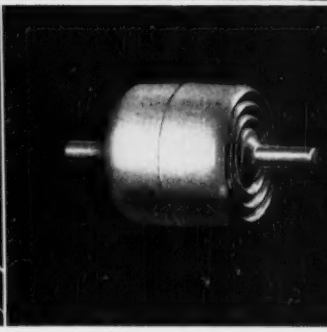
Electronic Industry



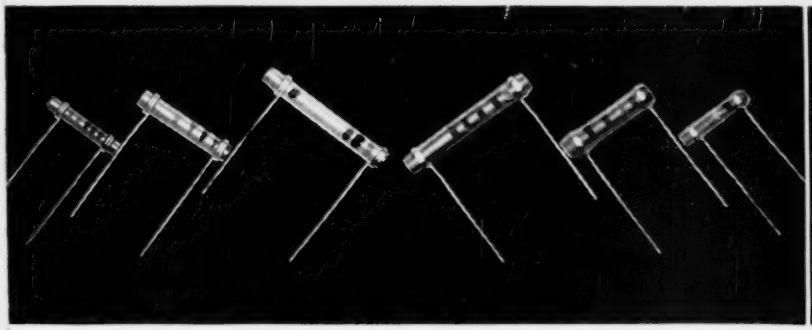
3 CRL's new Tubular *Trimmers* come in 3 basic types, 3 capacity ranges. Tinnerman locknut and adjusting screw available on special request.



4 For by-pass or coupling applications, check Centralab's original line of ceramic disc *Hi-Kaps*. Disc *Hi-Kaps* are smaller than a dime!

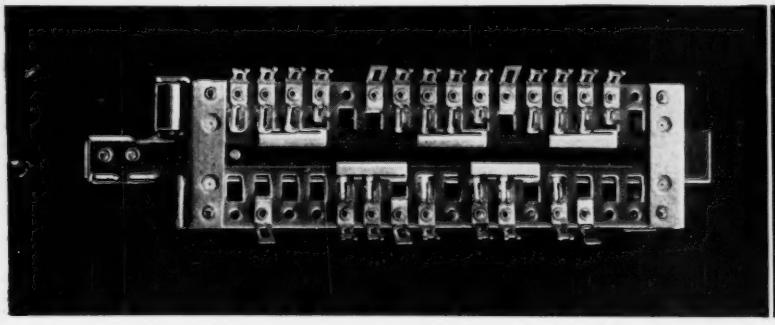


5 *Hi-Vo-Kaps* are filter and by-pass capacitors combining high voltage, small size and variety of terminal connections to fit most TV needs.

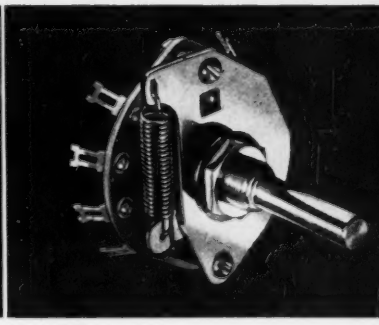


6 Centralab's TC (Temperature Compensating) Tubular *Hi-Kaps*, left, are the most stable capacitors available. With TC *Hi-Kaps*, there's practically no variation due to aging or changes in temperature or humidity. For applications where temperature compensation is unimportant, use Tubular BC *Hi-Kaps*, right.

7 *Ceramic Trimmers* are made in five basic types. Full capacity change within 180° rotation. Spring pressure maintains constant rotor balance.



8 Centralab's development of a revolutionary, new *Slide Switch* gives you improved AM and FM performance! Flat, horizontal design saves valuable space, allows short leads, convenient location to coils, reduced lead inductances for increased efficiency in low and high frequencies. CRL *Slide Switches* are rugged and dependable.



9 Great step forward in switching is CRL's New *Rotary Coil and Cam Index Switch*. Its coil spring gives you smoother action, longer life.

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Look to CENTRALAB in 1949! First in component research that means lower costs for the electronic industry. If you're planning new equipment, let Centralab's sales and engineering service work with you. For complete information on all CRL products, get in touch with your Centralab Representative. Or write direct.

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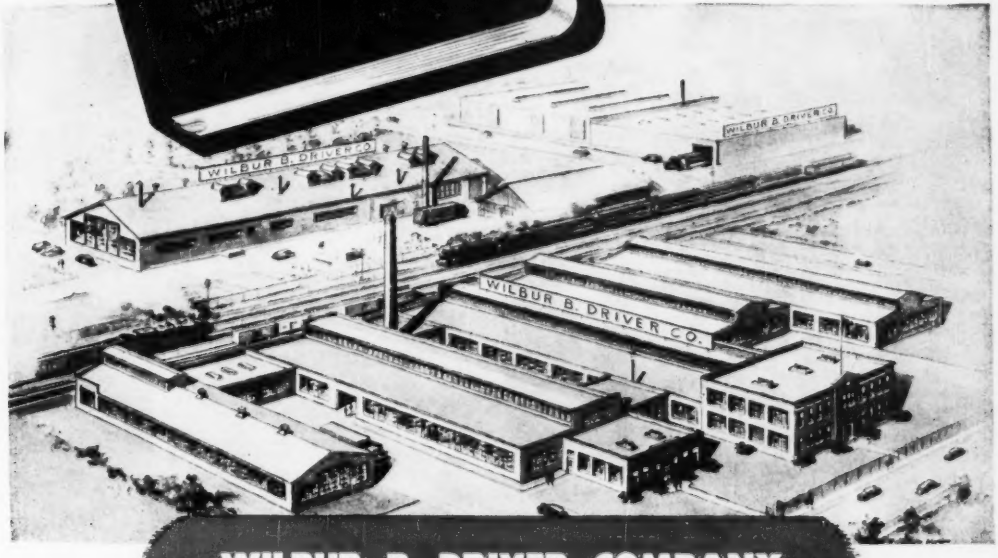
THIS NEW 128-PAGE RESISTANCE HANDBOOK

A complete, authoritative reference handbook compiled by Wilbur B. Driver Company to guide you in the correct selection of resistance and special alloys. Engineers and purchasing officials may obtain a copy without obligation by writing on company letterhead.

COMPOSITE VIEW OF THE THREE WILBUR B. DRIVER CO. PLANTS



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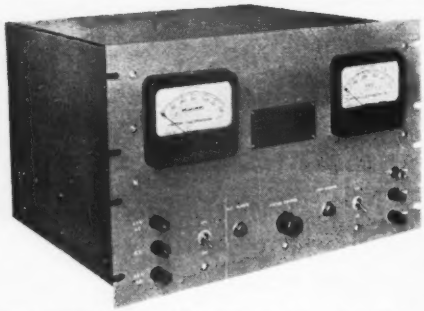
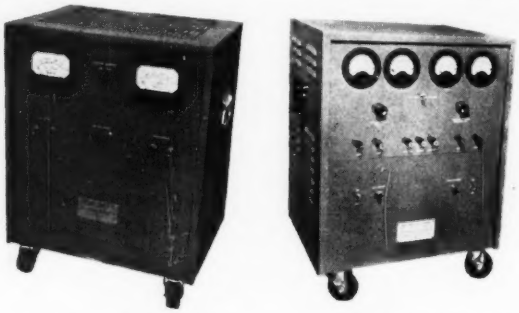
½% REGULATION! WITH THE NEW "A.E.C" REGULATED POWER SUPPLY UNITS

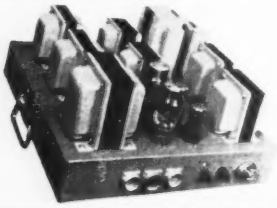


Right: **MODEL PSR-102**...200 to 1000 volts D.C. at 0 to 500 ma. 6.3 volts A.C. center-tapped at 10 amp; ½% or better regulation under any conditions of operation within ratings. 20 MV. or less peak-to-peak ripple voltage. Output impedance effectively zero. High voltage continuously variable from 0 to 1000 volts.
NET PRICE F.O.B. FACTORY.....**$695.00**

Left: **MODEL PSR-100**...30 to 500 volts D.C. at 0 to 300 ma. 6.3 volts A.C. center-tapped at 6 amp; ½% or better regulation under any conditions of operation within ratings. 10 MV. or less peak-to-peak ripple voltage. Output impedance effectively zero. High voltage continuously variable from 0 to 500 volts.
NET PRICE F.O.B. FACTORY.....**$395.00**

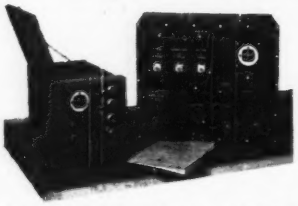


Above, right: **MODEL PSR-105**...200 to 400 volts D.C. at 0 to 200 ma. from each of two separately controlled outputs, or 200 to 400 volts D.C. at 0 to 400 ma. 6.3 volts A.C. center-tapped at 10 amp; ½% or better regulation under any conditions of operation within ratings. 10 MV or less peak-to-peak ripple voltage. Output impedance effectively zero. Output voltages continuously variable. NET PRICE F.O.B. FACTORY.....**$695.00**



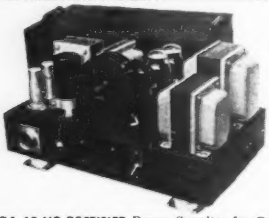
TCS POWER SUPPLY MODEL PS-106. Designed for use with U.S. Navy type TCS-1 thru TCS-12 transmitter-receiver for 110 or 220 volt A.C. applications. INPUT: 110/220 volts A.C. 50/60 C.P.S. OUTPUT: 400/450 volts D.C. at 200 ma. 225 volts D.C. at 120 ma. 12 volts D.C. at 1.5 amp. 12.6 volts A.C. at 4 amp
NET PRICE F.O.B. FACTORY.....**$200.00**

TEST EQUIPMENT FOR AIRCRAFT INSTRUMENT LANDING SYSTEMS



TS/67-C ILS SIGNAL GENERATOR....A crystal-controlled RF signal generator for sensitivity measurements and alignment of glide path and localizer receivers. Frequency coverage: 332.6, 333.8, 335, 108.3, 108.7, 109.1, 109.5, and 110.3 mcs.
NET PRICE F.O.B. FACTORY.....**$1,100.00**

TS/170-C GLIDE PATH TEST SET...Battery operated portable test oscillator which provides a crystal-controlled signal at 332.6, 333.8 or 335 mcs., which may be 30% modulated from an internal source at 90, 150, 1000 cps. or unmodulated as desired, for glide path channels GX, GY, and GZ.
NET PRICE F.O.B. FACTORY.....**$190.00**



RA-62 VG RECTIFIER Power Supplies for Ground Station Operation of SCR 522 VHF Radio. SPECIFICATIONS: INPUT: 110/120/220/240 volts A.C. 50-70 cps. 225 watts. OUTPUT: 300 volts D.C. at 300 ma. 150 volts D.C. at 30 ma. 13 volts D.C. at 4.4 amp.
NET PRICE F.O.B. FACTORY.....**$138.00**

TS/173-C LOCALIZER TEST SET—*Left*...Battery operated portable test oscillator which provides a crystal-controlled signal at 108.3, 108.7, 109.1, 109.5, 109.9, or 110.3 mcs., which may be 30% modulated from an internal source at 90, 150, 1000 cps. or unmodulated as desired, for localizer channels U, V, W, X, Y and Z.
NET PRICE F.O.B. FACTORY.....**$200.00**

MB-2 MARKER BEACON TEST UNIT—*Right*...A crystal controlled, portable, 75-megacycle transmitter whose output may be tone-modulated at 400, 1300 or 3000 cycles per second, as desired.
NET PRICE F.O.B. FACTORY.....**$140.00**

American Electroneering Co.

Additional information, all units, available on request.

2112 South LaBrea Avenue · Los Angeles 16, California
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Plastics where plastics belong

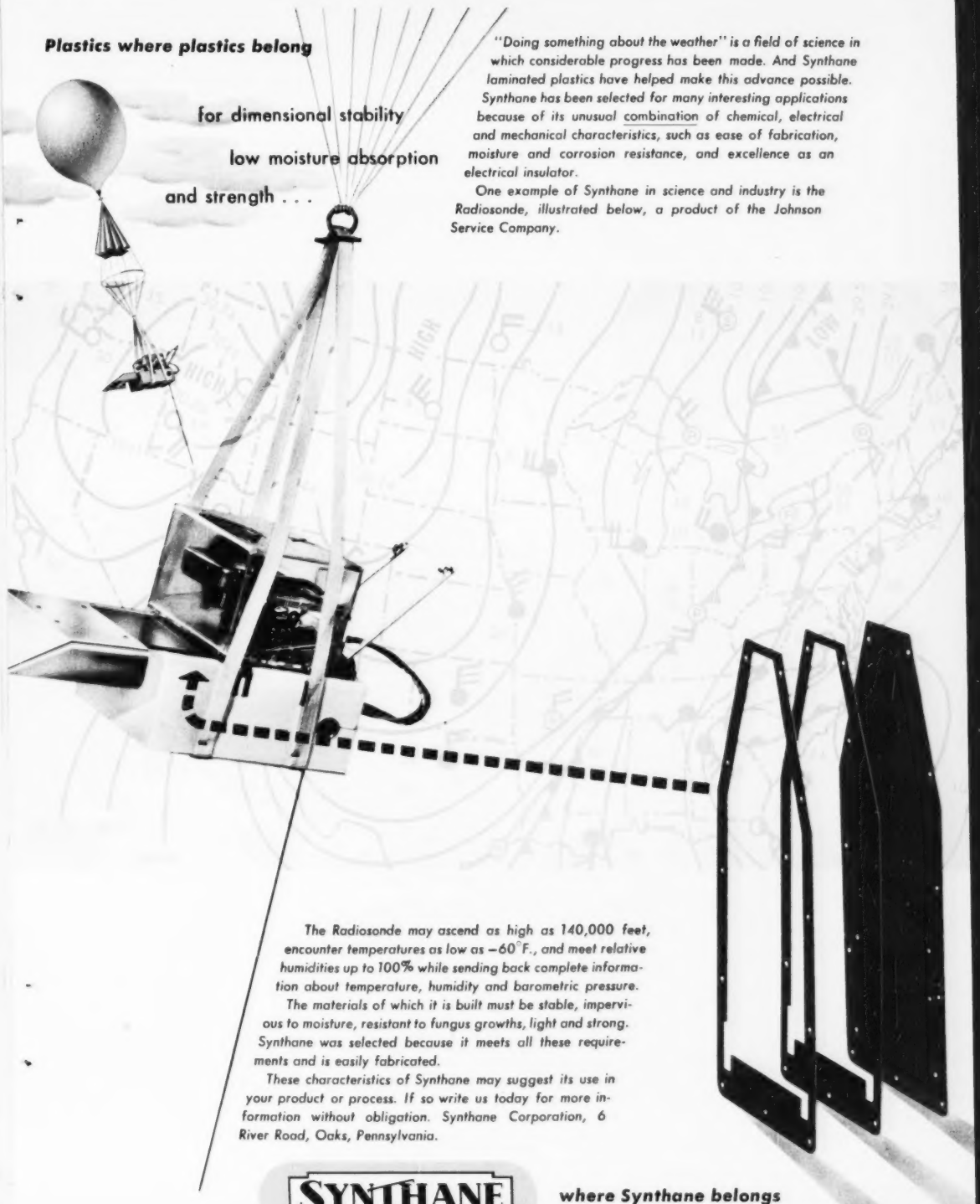
for dimensional stability

low moisture absorption

and strength . . .

"Doing something about the weather" is a field of science in which considerable progress has been made. And Synthane laminated plastics have helped make this advance possible. Synthane has been selected for many interesting applications because of its unusual combination of chemical, electrical and mechanical characteristics, such as ease of fabrication, moisture and corrosion resistance, and excellence as an electrical insulator.

One example of Synthane in science and industry is the Radiosonde, illustrated below, a product of the Johnson Service Company.



The Radiosonde may ascend as high as 140,000 feet, encounter temperatures as low as −60° F., and meet relative humidities up to 100% while sending back complete information about temperature, humidity and barometric pressure. The materials of which it is built must be stable, impervious to moisture, resistant to fungus growths, light and strong. Synthane was selected because it meets all these requirements and is easily fabricated.

These characteristics of Synthane may suggest its use in your product or process. If so write us today for more information without obligation. Synthane Corporation, 6 River Road, Oaks, Pennsylvania.

SYNTHANE

where Synthane belongs

SHEETS • RODS • TUBES • FABRICATED PARTS • MOLDED-LAMINATED • MOLDED-MACERATED

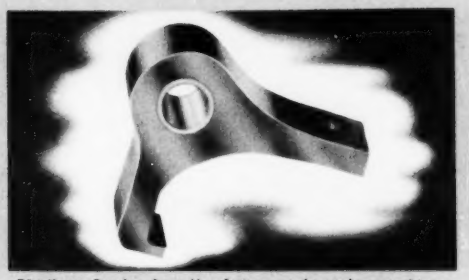
LOOK

at the extra values

Over at the right are four parts made of Synthane laminated plastics. Synthane was selected for these important jobs because of one or two mechanical, chemical or electrical characteristics. In each application the user found that Synthane was not only a better material in the major requirement but it gave him a valuable and desirable extra by reason of other beneficial properties. This is true of almost every Synthane application because our type of laminated plastics is unusual for its *combination* of values.

Synthane is strong, light, hard, and dense. An excellent electrical insulator, it has high dielectric strength, low dielectric constant, and low power factor. Highly resistant to moisture, abrasion, corrosion, and wear, Synthane is easily worked on production equipment. It is a *set* plastic, dimensionally stable over wide variations of temperature.

If these few of Synthane's many desirable properties and abilities suggests its use in your product or process, clip and mail the coupon today, let us help you with materials, design or fabrication of parts.



Distributor Breaker Arm. *Manufacturer sought good wear resistance and electrical insulating ability. His extra values: Impact fatigue resistance, low moisture absorption, vibration absorption.*

Piping for Nylon Sizing Machine. *Designer needed good corrosion resistance. His extra values: Light weight, strength.*

Vee Belt Pulley. *User required light weight. His extra values: Wear resistance, stability, low power loss, reduced lubrication problem.*

Hosiery Examining Form. *Processor looked for smooth, non-sagging surface. His extra values: Rigidity, light weight, black finish all-the-way-through, freedom from warping, hardness.*

FOR MORE INFORMATION ABOUT YOUR EXTRA VALUES

SYNTHANE CORPORATION, 6 River Road, Oaks, Pa.

Gentlemen:

Please send me without obligation a complete catalog of Synthane technical plastics.

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Says GENE ANTHONY
Manager, Service Department
General Electric Supply Corp.
New York City

"MAKES TV SET ALIGNMENT EASY"

IN the biggest, fastest, toughest TV market in the world, TV set alignment is no longer a difficult, time-consuming job. Three new coordinated G-E test equipments now assure ease, speed, and accuracy in this work.

Says Gene Anthony, one of the best known service managers in New York: "The new G-E Test Equipment Package has improved our operation tremendously. Alignment work that used to require all the time of specialists in our shop *is now performed with full confidence by any one of our men.* Operation and controls of the three instruments—Variable Permeability Sweep Generator, Crystal Controlled Marker Generator, and Cathode Ray Oscilloscope—are simple and easy to understand and can be taught quickly.

"With this equipment we do all kinds of TV service work—including mass alignments and the servicing of head ends as separate units."

You can put your confidence in—

GENERAL ELECTRIC

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Send me complete data on the new G-E Television Test Package.

NAME_____

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The Leyden Jar

Between 1745 and 1750 divers Europeans were experimenting excitedly with The Leyden Jar. Dr. Priestly declared its discovery to be "the most surprising yet made in the whole business of electricity."

Early in 1747 Peter Collinson, fellow of the Royal Society, sent an "electrical tube" to his friend, Benjamin Franklin, in Philadelphia. As usual Dr. Franklin had some ideas of his own* and used a Leyden Jar in his famous lightning-kite experiment. It was Franklin who identified the principle and improved on the jar with the simple "Franklin Pane," a piece of glass with tinfoil on each side. Today's condensers are practically piles of Franklin Panes.

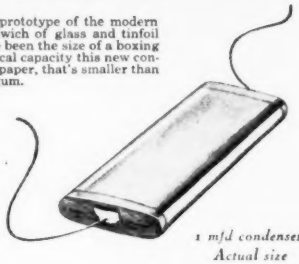
*Puckish old Ben even made a "magic portrait" of the King out of metal on glass with a removable crown. When an uninstructed person attempted to remove the crown he received a "tremendous shock." This served as a warning for too ardent patriots.

That's better Dr. Franklin, but–

The Franklin Pane

The "Franklin Pane," prototype of the modern condenser, was a sandwich of glass and tinfoil and would have to have been the size of a boxing ring to equal in electrical capacity this new condenser, made of Smith paper, that's smaller than a package of chewing gum.

–this one will go in your pocket



1 mfd condenser Actual size

It was Franklin who took the first step toward the modern condenser. The most recent step in its improvement has been taken by Smith Paper, Inc. of Lee, Mass.

Smith has been making very thin papers for years — papers as thin as .00025 in. With the growth of electronics Smith's condenser paper became a product of considerable industrial importance.

An ordinary condenser is a roll of many alternate layers of conducting metal and non-conducting paper each of which, for compactness, should be as thin as possible. But there are limits to their thinness for should a momentary overload break through the insulator the condenser is short circuited and ruined.

Now, with the help of National Research, Smith has found a way to greatly reduce the size of condensers and prevent most shorts at the same time. In our continuous coating machines Smith evaporates metal under high vacuum. The metallic vapor, deposited on a moving strip of lacquered paper, forms a conducting film only 3 to 5 millionths of an inch in thickness. This is only 1/50 of the thickness of the foil formerly used. This metal-coated paper is also self-healing. If a momentary excess of voltage should puncture the paper the zinc coating vaporizes and recedes from the edge of the hole where it can make no contact with the next conducting layer. Extra layers of paper for insulation insurance are no longer necessary.

So, with 1/50 of the conductor and a half (or less) of the insulator the new Smith paper saves about 75% in the bulk of the finished condenser. Such a decrease in size and increased life expectancy are great advantages to all makers of television and other electronic equipment.

Isn't it cheaper to make a better product than to promote an ordinary one? We at National Research believe, by the evidence of our own experience, that it is. And we also believe that in the unexploited uses of industrial research lie the greatest opportunities for profit now offered to industry. To industry — to *your* business — we can bring the best in brains, organization and equipment with an unequalled accumulation of experience.

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HIGH VACUUM ENGINEERING & EQUIPMENT
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NATIONAL RESEARCH CORPORATION

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In the United Kingdom, BRITISH-AMERICAN RESEARCH, LTD., London S.W. 7, England—Glasgow S.W. 2, Scotland

Imitated in flux and construction but never equalled by any solder at any price!

ERSIN Multicore

TECHNICAL ADVANTAGES:

MULTICORE SOLDER

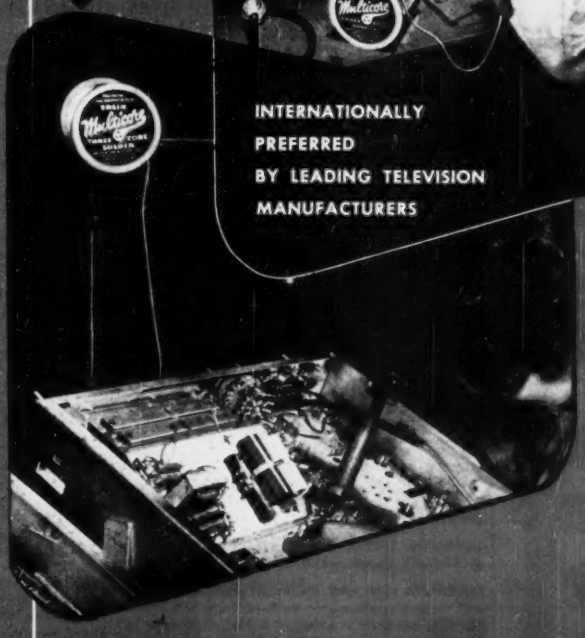
- Three separate cores of flux eliminate possibility of no flux in a portion of the wire, which may occur in single cored solder. Guaranteed continuity of the flux stream prevents "dry" joints, i. e. those having high electrical resistance.
- Although there are three cores of flux in Multicore, the total percentage of flux to solder is less than many single cored solders.
- Very rapid melting results from the multiple core construction which provides thinner walls of solder than are found in same gauge single cored solder.
- Multicore's unique properties make perfect joints possible on difficult metals and alloys, even if oxidised.
- Ability to fix rapidly produces perfect joints with less solder. Greater coverage per pound.

ERSIN FLUX

- Ersin Flux is exclusive to Multicore and will not be found in any other solder. It is a high grade, water white resin, homogeneously activated.
- Ersin Flux has a vigorous fluxing action and possesses the non-corrosive and protective features of the original resin.
- Soldered joints made with Ersin Flux do not corrode even after prolonged exposure to any degree of humidity. It has been tested under climatic conditions ranging from the Arctic to the Tropics.
- Ersin Flux reduces the surface tension of molten solder, causing it to wet metals rapidly, increasing speed of operation with resultant production economies.
- Free from objectionable odor. Non-toxic in use.
- Leaves nothing but pure resin on the work after soldering, and may be used wherever pure resin is specified. Complies with all pertinent Federal Specifications.

Shown in use at Pye Ltd. Laboratories in England.

Shown in use at Allen B. DuMont Laboratories, Inc. in the U. S. A.



INTERNATIONALLY PREFERRED BY LEADING TELEVISION MANUFACTURERS

The World's Finest 3-core Solder. The only solder made with non-corrosive, extra-active ERSIN FLUX!

All popular gauges and alloys available from New York stock

Write for Helpful Booklet "SOLDERS AND SOLDERING"

Address U. S. A. and Canadian inquiries to

MULTICORE SALES CORP.

164 Duane Street • New York 13, N. Y.

Inquiries regarding other territories to

MULTICORE SOLDERS LTD.

Mellier House, Albemarle Street • London, W. 1, England

Cut Costs! Select The *Right*

Typical Parts from ROGERS MATERIALS

SLOT CELL

INSULATOR

INSERT

GASKET

GUARD

PUNCHING

SHIELD

COVER

GOGGLES

INSULATOR

BUMPER

LATCH

HANDLE

PROTECTOR

HOUSING

PLUG

LOWER COSTS for BETTER PARTS

Here is a checklist of fibrous and plastics materials, at least one of which probably goes into the products you make. And here are the services Rogers is equipped to perform in connection with those materials.

From blueprint to production line, Rogers can help at every step . . . often by drastic cost reductions. Whether your part is a simple paper punching or a complex plastics unit, Rogers' experience in materials manufacturing and fabrication can usually achieve two things: 1. Lower costs. 2. Get it done.

Rogers is objective on materials, effective on fabrication.

For additional information on any material or service listed, please write, wire, or phone. Rogers Corporation, 107 Mill Street, Manchester, Connecticut. Telephone: Manchester 5163.

CREATORS AND FABRICATORS
ROGERS
FIBROUS AND PLASTIC MATERIALS

FOUNDED 1832

GENERAL DESCRIPTION OF ROGERS MATERIALS

PLASTICS MATERIALS

ROGERS BOARDS*. ***For molding.*** **Ideal for parts requiring high flexural and high impact strength, these thermo-setting phenolic resin boards are fast-curing, have a low bulk factor, and are available in the form of sheets, strips, and time-saving pre-cut blanks and stamped pre-shaped preforms ready for loading in the mold.**

For laminating. **These phenolic resin boards are formulated for laminating to produce punching, decorative, and other laminated sheet stock.**

MOLDICE*. **(Diced ROGERS BOARDS). Molding materials with medium-high impact strength and low bulk factor which may be preformed on automatic tabletting machines. They may be compression, transfer, or plunger molded.**

LURON. **These are medium-high impact phenolic molding materials with excellent finish, low bulk factor, good preformability and good moldability. They can be made in colors and special formulations and may be compression, transfer, or plunger molded.**

TEMFLEX. **These are thermoplastic boards which may be laminated or used without further application of heat and pressure, depending upon the plastic used in its formulation.**

LAMINATED SHEETS. **These are ROGERS BOARDS or TEMFLEX boards which have been laminated.**

PRE-SHAPED PREFORMS. **Pre-shaped preforms, either cast as pulp preforms, or stamped from ROGERS BOARDS, constitute a means of quicker molding of stronger parts. The material is in the shape of the mold, ready for drop-in by the operator.**

***Materials made by Rogers and formerly marketed by Bakelite Corporation under Bakelite BM numbers. Now made and marketed by Rogers.**

SPECIALTY FIBRE BOARDS

DUROIDS. **These materials combine cellulose fibres and non-phenolic resin. The DUROIDS, although they are rigid, tough boards with high impact strength, have sufficient resiliency to be formed, drawn and shaped. Their characteristics are similar to vulcanized fibre but they are not brittle. Various grades are available to meet special requirements.**

3G443. **This material is a blend of new cotton cuttings, kraft pulp and a thermoplastic resin that adds rigidity and stiffness. Sizing provides moisture resistance.**

3G316. **Made from a combination of chemical wood fibres — and rosin-sized — this material is useful and economical for mechanical applications not requiring electrical insulating qualities.**

SHOE MATERIALS

These products are deft blends of elastomers and other materials, in combination with cellulose fibres. DURAMID and BAYFLEX feature high strength and the ability to hold stitching, and may be cut and trimmed easily and cleanly.

ELECTRICAL INSULATING PAPERS AND BOARDS

Neutral as well as chemically and electrically clean, these materials have excellent heat-aging characteristics and high dielectric strength.
DURO is made from 100% new, selected cotton cuttings; KAYGREY from 50% new cotton cuttings and 50% kraft; KAYROK from 100% purified non-cotton cellulose. KAYPAR is made from 100% kraft pulp; ROYALGREY from 75% new cotton cuttings and 25% kraft pulp. Thicknesses in these materials range from .007" to .125". In many applications, these materials can be used for both electrical insulating and structural purposes.

SPECIAL FORMULATIONS

Rogers' manufacturing and research facilities permit the development of special formulations involving various combinations of vegetable, mineral or animal fibres with natural or synthetic resins and other addition agents. Production samples can be produced with as little as 25 lbs. of raw materials.

Data and samples of materials will be sent promptly upon request.

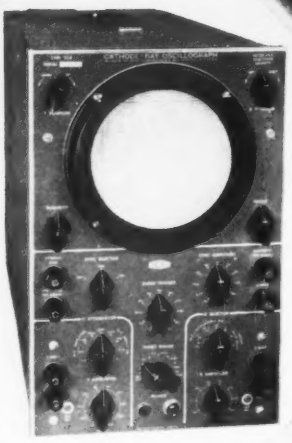
Material For Your Application

GUIDE TO MATERIALS AND SERVICES AVAILABLE FROM ROGERS

	THESE SERVICES ARE PERFORMED BY ROGERS IN CONNECTION WITH THE FOLLOWING MATERIALS	MOLDING CONSULTATION	STAMPED PRE-SHAPED PREFORMS	CAST PRE-SHAPED PREFORMS	LAMINATING	PARTS DESIGN	DIE DESIGN	DIE CONSTRUCTION	PUNCHING & BLANKING	DIE CUTTING	SLITTING OR SHEARING	SAWING	MACHINING	DRAWING	FORMING	BENDING	EMBOSSING	ENGRAVING	IMPREGNATING	WAXING	COATING	VARNISHING	PAINTING	STITCHING, STAPLING & RIVETING
PLASTICS MATERIALS	ROGERS BOARDS	●	●		●				●	●	●			●	●	●					●			
	MOLDICE	●																						
	LURON	●																						
	TEMFLEX				●		●	●	●	●	●					●	●			●	●			
	LAMINATED SHEETS						●	●	●	●	●	●	●		●	●				●		●		
	ROGERS SPECIAL FORMULATIONS	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SPECIALTY FIBRE BOARDS	DUROIDS					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	3G443					●	●	●	●	●	●				●	●	●		●	●	●	●	●	●
	3G316					●	●	●	●	●	●					●	●		●	●	●	●	●	●
SHOE MATERIALS	DURAMID										●						●		●		●			
	BAYFLEX										●						●		●		●			
ELECTRICAL INSULATING PAPERS AND BOARDS	DURO					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	KAYGREY					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	KAYROK					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	KAYPAR					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	ROYALGREY					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
MATERIALS NOT MANUFACTURED BY ROGERS	LAMINATED PLASTIC SHEETS						●	●	●	●	●	●	●		●	●		●		●		●		
	HARDBOARDS					●	●	●	●	●	●	●	●			●				●	●	●	●	
	VULCANIZED FIBRE					●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	●
	FISHPAPER					●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●
	VARNISHED CAMBRIC					●	●	●	●	●	●													
	PAPER					●	●	●	●	●	●						●		●	●	●	●	●	●
	FIBRE BOARDS					●	●	●	●	●	●				●	●			●	●	●	●	●	●
	CHIP BOARDS					●	●	●	●	●	●					●			●	●	●	●	●	●
	IMITATION PRESSBOARD					●	●	●	●	●	●					●			●	●	●	●	●	●
	THERMOPLASTIC SHEET						●	●	●	●	●			●	●	●	●							

EXTRA COPIES OF THIS CHECKLIST MAILED ON REQUEST *JUST TELL US HOW MANY YOU WANT AND WE'LL SEND BY RETURN MAIL.*

A New Standard of Performance for Cathode-ray Oscillographs



DUMONT TYPE 304-H

NEVER BEFORE HAVE THESE FEATURES BEEN COMBINED IN *ONE* INSTRUMENT AND OFFERED AT SUCH *LOW COST!*

HIGH-GAIN AMPLIFIERS X- AND Y-AXES

Sensitivity: X-Axis, 50 millivolts rms per inch (AC and DC). Y-Axis, 10 millivolts rms per inch (AC and DC).

Frequency Response: DC amp. X and Y Axes, 0-100,000 cps within 10%; 0-300,000 cps within 50%. AC amp. X and Y Axes, 20-100,000 cps within 10%; 20-300,000 cps within 50%.

No pattern "bop" even with sudden changes in signal level. Excellent stability and minimum microphonics and drift. Provision for applying signals directly to deflection plates.

STABILIZED SYNCHRONIZATION

Sync limiting provided on recurrent sweep, so that sweep length and synchronization are maintained as signal level varies.

EXPANSION OF DETAILS

Due to available deflection of over 4 times full-screen diameter on both X and Y Axes, performance equivalent to that of a 20-inch cathode-ray tube is possible, with the high resolution of a 5-inch screen. Full positioning is available over this entire expanded range on both axes.

RECURRENT AND DRIVEN SWEEPS

Variable from 2 to 30,000 cps. Sweep speeds faster than 0.75 inch/μsec. with fully expanded time base. Provision incorporated for sweeps of 10 seconds and slower through the connection of external capacitors at front-panel terminals. Sync amplifier with sync-polarity selection is provided.

INTENSITY MODULATION

Z-Axis input terminal on front panel is capacitively coupled to grid of cathode-ray tube. 15 volts peak will blank trace fully at normal intensity.

INCREASED ACCELERATING POTENTIAL

Du Mont Type 5CP-A Cathode-Ray Tube in the Type 304-H is operated at overall accelerating potential of 3000 volts, facilitating use of long-persistence screens to take full advantage of low-frequency recurrent sweeps, fast-driven sweeps, and DC amplifiers. Type 304, a lower-price version, is also available, operating at an overall accelerating potential of 1780 volts.

ADDITIONAL FEATURES

An engraved, permanently-mounted calibrated scale greatly facilitates quantitative measurements. Mu-Metal magnetic shield affords maximum protection of cathode-ray tube from effects of external magnetic fields. Du Mont Type 2501 Bezel permits attachment of such accessories as Du Mont Types 271-A or 314-A Oscillograph-Record Cameras.

MECHANICAL DETAILS

Height, 13½"; Width, 8⅝"; Depth, 19"; Weight, 50 lbs. Housed in metal cabinet with gray wrinkle finish. Panel reverse etched—white on gray.

TRIED AND PROVED

This oscillograph has undergone a most rigid field test both in our own laboratories and again in selected laboratories and institutions throughout the country. In a great variety of applications, every feature has been given a thorough workout. The Type 304-H is not a new instrument of unknown quality, but definitely an oscillograph of TRIED AND PROVED EXCELLENCE.

PRICES

Type 304-H, $307.50. Type 304, $285.00.

Full details of performance and applications are contained in a 12-page bulletin obtainable by writing to . . .

ALLEN B. DU MONT LABORATORIES, INC.

ALLEN B. DU MONT LABORATORIES, INC.
CLIFTON, NEW JERSEY

Presenting the Vector

No. 8-8M-12S
Plug-In

No. 10-O-9T
Octal

No. 8-N-9T
Noval

No. 6-M-6T
Miniature

SOCKET TURRET

A NEED FULFILLED

The Vector Socket-Turret is a new and unique terminal structure on which the circuit components associated with a vacuum tube may be neatly connected directly at the socket. This is accomplished by combining a tubular terminal post or "turret" with a standard type of vacuum tube socket. By this means stage sub-assemblies are readily formed and these can be quickly installed with a minimum of connections thus simplifying the construction of electronic equipment.

FOR COMPACT ASSEMBLIES

Space under the socket, usually wasted, can now be used effectively. Components may be mounted from socket to turret, entirely on the turret, or from one turret to another, thus achieving compactness without overcrowding.

A BOON TO THE EXPERIMENTER

Circuits can be wired quickly without fuss and planning as to mountings. Troubles caused by spurious coupling, stray capacitance, hum pickup are minimized due to short leads.

AN AID TO PRODUCTION

Cuts down on connections, terminal strips, cable forms, produces simplified sub-assemblies. Turrets are economical, neat and efficient.

MANY TYPES ARE AVAILABLE

Socket-Turrets are available for octal, loctal, miniature and noval tubes in a large variety of sizes and styles, including types for coil forms with tuning slugs.

Also available are Plug-In Socket-Turrets having octal style plugs at the end of the turret opposite the socket and with or without shield cans.

ASSEMBLED UNIT

PATENT PENDING

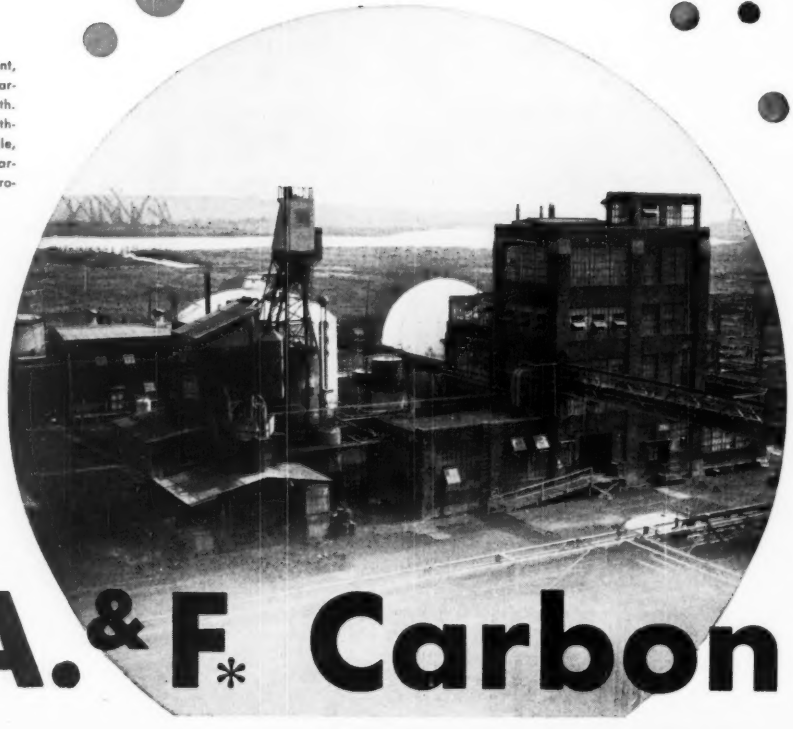
WRITE FOR DETAILED INFORMATION

Vector Electronic Company
1101 RIVERSIDE DRIVE
LOS ANGELES 31, CALIF.

Chemically Processed—Highly specialized chemical equipment, such as illustrated here, reacts carbon monoxide with iron-containing ores to form liquid iron pentacarbonyl. Further processing decomposes the liquid into the spheres which are Carbonyl Iron Powder. The closest attention to detail assures products of constantly uniform properties.

carbonyl iron

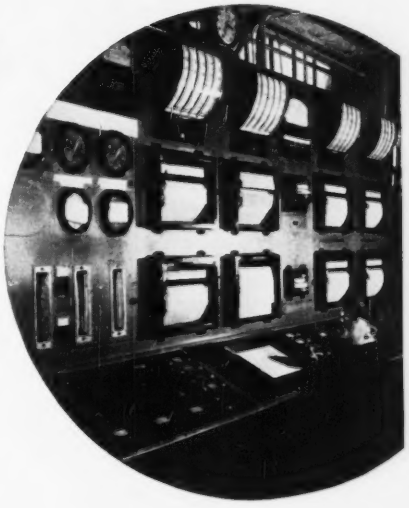
Plant Facilities—The Grasselli N. J. plant, right, was the sole producer of Carbonyl Iron Powders until this month. Now, increased production will be forthcoming from the new plant at Huntsville, Ala. The demand for all grades of Carbonyl Iron Powder has made this production increase necessary.



G. A. & F.* Carbon

Laboratory Controlled—Every batch of CIP must be put through very extensive laboratory tests to keep quality high. Test cores are made from every batch at the lab. Above, a small section of the test equipment.

powders are superior



Carbonyl Iron Powders are high quality products with low loss characteristics—superior in every way because this quality is achieved by strict control in processing. These high "Q" materials work best because they are manufactured and tested for quality under the most careful conditions.

Chemically, Carbonyl Iron Powders are high in iron with an absence of non-ferrous materials. Structurally, the particles are spherical, built up of concentric cells. Particle distributions range from 0.5 to 15 microns diameter. Some grades are mechanically hard and quite incompressible. Hysteresis loss is low, insulation is easy thus keeping eddy currents low. Particle size distribution is controlled.

The illustrations on these pages show to some extent the manufacture, the tests for quality, and the checks on control made by GA&F. For more detailed information on any problem involving Carbonyl Iron Powders write . . .

Production Controlled—Instruments, such as these, control the processes which make Carbonyl Iron Powders. Such control makes possible the constant uniformity of CIP. The panel above is one of many instrument boards used for controlling the processing of GA&F Carbonyl Iron Powders.

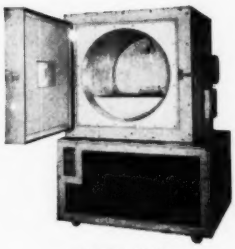
MEMBER mpa METAL POWDER ASSOCIATION

ANTARA* PRODUCTS
GENERAL ANILINE & FILM CORPORATION
444 Madison Ave.
New York 22, N. Y.
*®

yl Iron Powders

BOWSER
ESTABLISHED 1885

SUB ZERO



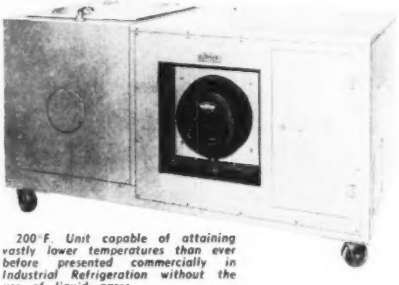
MODEL U-16

LABORATORY TEST CHAMBERS

Bowser refrigeration units, producing temperatures as low as minus-150 f., are designed to meet the rigid requirements of Industry in testing, processing and laboratory procedure. They are the result of many years of research and development . . . and are available in a number of standard models. Experienced Bowser engineers will design special units to meet specific requirements.

1. **LABORATORY UNITS** . . . for the user who requires varying conditions of temperature, altitude and relative humidity. A typical application . . . complete testing of aircraft instruments under various conditions of flight.
2. **INDUSTRIAL UNITS** . . . for the user whose requirements do not call for conditions of high altitude or relative humidity, but low temperatures only. A typical application . . . the expansion fitting of bushings.
3. **UTILITY UNITS** . . . for the user who does not require the accuracy of our Laboratory Units. A typical application . . . production line spot checking of radio components.

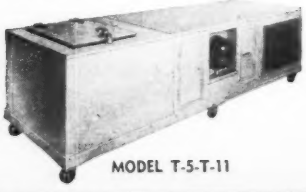
BOWSER SPECIAL ENGINEERING



200° F. Unit capable of attaining vastly lower temperatures than ever before presented commercially in Industrial Refrigeration without the use of liquid gases.

Achievements obtained through many years of research are now available to you through Bowser's Special Engineering Service Program. This service offers you the results of the engineering functions performed in conjunction with the standard line of Bowser products. Write for complete description.

4. **RELATIVE HUMIDITY UNITS** . . . for the user whose products are not affected by low temperature or high altitude, but by moisture only. A typical application . . . testing for the moisture content of paper as it is being processed.
5. **ALTITUDE — VACUUM UNITS** . . . for the user whose products or testing requirements are not affected by temperature or humidity, but who is primarily interested in noting the effect of varying atmospheric pressures. A typical application . . . testing and proving the advantages or limits of vacuum packaging, as well as standard aircraft testing.



MODEL T-5-T-11

OTHER BOWSER UNITS

Some of the many Bowser Units are shown and briefly described on this page. They have a wide scope of operation throughout industry, not only in laboratory research but in the production of plastics, liquids, metals, instruments, chemicals, etc. Complete details regarding any of them are available upon request.

BOWSER, INC. REFRIGERATION DIVISION — 420 LEXINGTON AVE., N. Y. C.

IN CANADA: S. F. BOWSER CO., LTD., 344 SHERMAN AVE., HAMILTON, ONTARIO

DRIVER-HARRIS

Your dependable source for

Wire and Ribbon
Resistor and Radio Alloys

FOR RESISTANCE

There are Driver-Harris Alloys for every electrical resistance requirement. Most widely used are:

. . . **Nichrome*** and **Nichrome* V**, for winding large value resistors where overall size is limited, but dependability is a must.

. . . **Manganin**, for fixed stability and constant resistance under normally variable operating conditions; examples being precision bobbins, potentiometers, National Bureau of Standards type resistance standards.

. . . **Advance***, most frequently specified for precision resistors in electric meters and laboratory testing devices, because in its finer sizes it has a temperature coefficient of only ±.00002/°C.

. . . **Karma***, high ohmage, 800 ohms/cmf at 20°C., makes possible extremely small resistors. Especially suitable for service in resistors requiring negligible temperature coefficient of resistance. Thermal e.m.f. against copper only .002 millivolts /°C. between 0°C. and 100°C. Where mechanical strength is important, larger diameter Karma wire can be used for a given resistance per foot.

. . . Plus a total of more than 80 *electrical heat and corrosion-resistant* alloys which singly, or in combination fill any electrical resistance specifications.

FOR RADIO

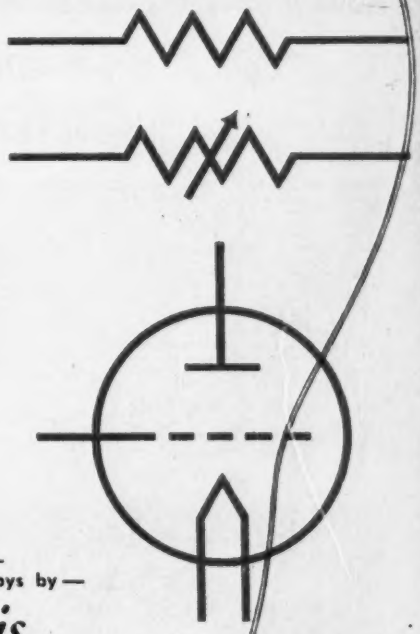
Always abreast of the latest developments in radio metallurgy, Driver-Harris has been headquarters for Radio Alloys since the earliest days of the industry. In greatest demand are:

. . . **Nickel and Nichrome***, for plate strip. Thin but rigid, they take a tightly adhering heat radiation coat.

. . . **Gridnic* Alloys**, having a very low electron emission — especially suitable in tubes where back-emission is involved.

. . . **Cathode Sleeve Material**: special melted Nickel Alloys to meet any emission requirements.

Other widely accepted D-H Alloys, meeting or exceeding most radio specifications are: *Nilvar**, *#42 Alloy*, *#52 Alloy*, and *Nickel "A"*, *"D"*, *"E"*, *"Z"*.

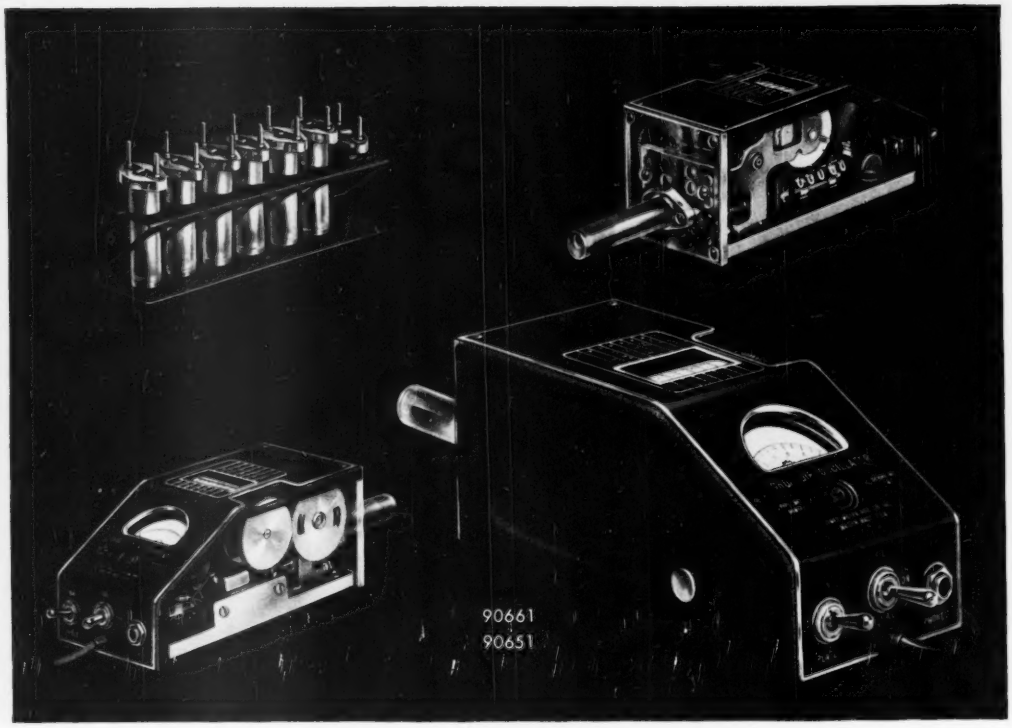


For efficiency and dependability —
Specify Electrical Resistance and Radio Alloys by —

Driver-Harris
COMPANY
HARRISON • NEW JERSEY

BRANCHES: Chicago • Detroit • Cleveland • Los Angeles • San Francisco • Seattle
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

*Trade Mark Reg. U. S. Pat. Off.



Designed for Application

GRID DIP METER

The No. 90661 Industrial Grid Dip Meter and its companion, No. 90651 standard Grid Dip Meter, are calibrated stable rf oscillator units with a meter to read grid current. The frequency-determining coil is plugged into the unit so that it may be used as a probe.

These instruments are complete with a built-in transformer type A.C. power supply and internal terminal board to provide connections for battery operation where it is desirable to use the unit on antenna measurements and other usages where A.C. power is not available. Compactness has been achieved without loss of performance or convenience of usage. The incorporation of the power supply, oscillator and probe into a single unit provides a convenient device for checking all types of circuits. The indicating instrument is a standard 2 inch General Electric instrument with an easy to read scale. The calibrated dial is a large 270° drum dial which provides seven direct reading scales, plus an additional universal scale, all with the same length and readability. Each range has its individual plug-in probe completely enclosed in a contour fitting polystyrene case for assurance of permanence of calibration as well as to prevent any possibility of mechanical damage or of unintentional contact with the components of the circuit being tested.

The No. 90661 and No. 90651 Grid Dip Meters may be used as:

1. A Grid Dip Oscillator
2. An Oscillating Detector, or
3. A Signal Generator
4. An Indicating Absorption Wavemeter

The most common usage of the Grid Dip Meter is as an oscillating frequency meter to determine the resonant frequencies of de-energized tuned circuits.

The No. 90661 Industrial Grid Dip Meter is completely calibrated for laboratory use and incorporates features desired for both industrial and laboratory application, such as a 3 wire grounding type power cord. The Industrial Grid Dip Meter and its associated coils are furnished in a suitable carrying case.

The No. 90651 standard model Grid Dip Meter is a somewhat less expensive version of the Grid Dip Meter. The calibration, while adequate for general usage, is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case.

The No. 90661 Industrial model is available direct from the Instrument Division. The Standard Model 90651 is carried in stock by franchised distributors.

Frequency Range: 1.7 to 300 megacycles in seven overlapping ranges

Size of Grid Dip Meter only (less probe): 7 in. x 3 3/16 in. x 3 5/8 in.

Millen Laboratory Instruments are illustrated and described in the new printing of our Laboratory Equipment catalogue, a copy of which will be mailed upon request.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN, MASSACHUSETTS, U.S.A.

Spotlighting...

G-E IGNITRONS FOR 3-PHASE WELDER CONTROL

"THESE TUBES HAVE HIGH RATED PERFORMANCE TO MEET THE DEMANDS OF WELDING'S NEW, MORE EFFICIENT METHOD."

INDUSTRY has welcomed 3-phase design in welders because peak power needs are much less, and the load is balanced . . . weldability is better . . . heavier welds can be made . . . throat depths can be increased with little or no extra power needs . . . metals of many types, from steels to aluminum alloys, can be welded on the same machine.

This is an impressive list of plusses, and to control 3-phase welding with its greater demands on the tubes in the circuit, ignitrons must have superior capacity for handling high peak currents without arc-backs.

Type GL-5822 is an example of how General Electric meets new industrial-tube needs with new designs. A special internal baffle speeds up de-ionization of the mercury vapor. This permits high current peaks, minimizing the risk of arc-back. In its other features, the tube is a standard G-E ignitron for power conversion and control—sturdily made, dependable, long-lived.

To select the right ignitron for your 3-phase welder-control circuit, first check the list below. Then telephone your nearby G-E electronics office for further information and guidance. Or wire or write *General Electric Company, Electronics Department, Schenectady 5, New York.*

VOLTAGE AND CURRENT LIMITS FOR 3-PHASE WELDING

Ignitron type	Peak voltage forward and inverse	*Max. peak and avg. anode current	
GL-5822	1,200 v	1,500 amp	20 amp
		420 amp	70 amp
GL-5554/FG-259-B	2,100 v	600 amp	75 amp
GL-5555/FG-238-B	2,100 v	1,200 amp	150 amp

*Straight-line interpolation on log-log paper is allowed between corresponding current points.

GENERAL ELECTRIC

180-N30

FIRST AND GREATEST NAME IN ELECTRONICS

"Clocked" in Record Time

No. 102's at Five Star Company increase production by synchronizing output on basis of time required for manual operations

Experience of the Five Star Company, West Chesire, Conn., shows how one manufacturer can profit from use of Universal Coil Winding Machines.

This company, manufacturing a variety of coils, uses the No. 102 Winders shown below to produce coils for electric clocks, winding six coils at a time from unrolling spools of No. 38 enameled wire.

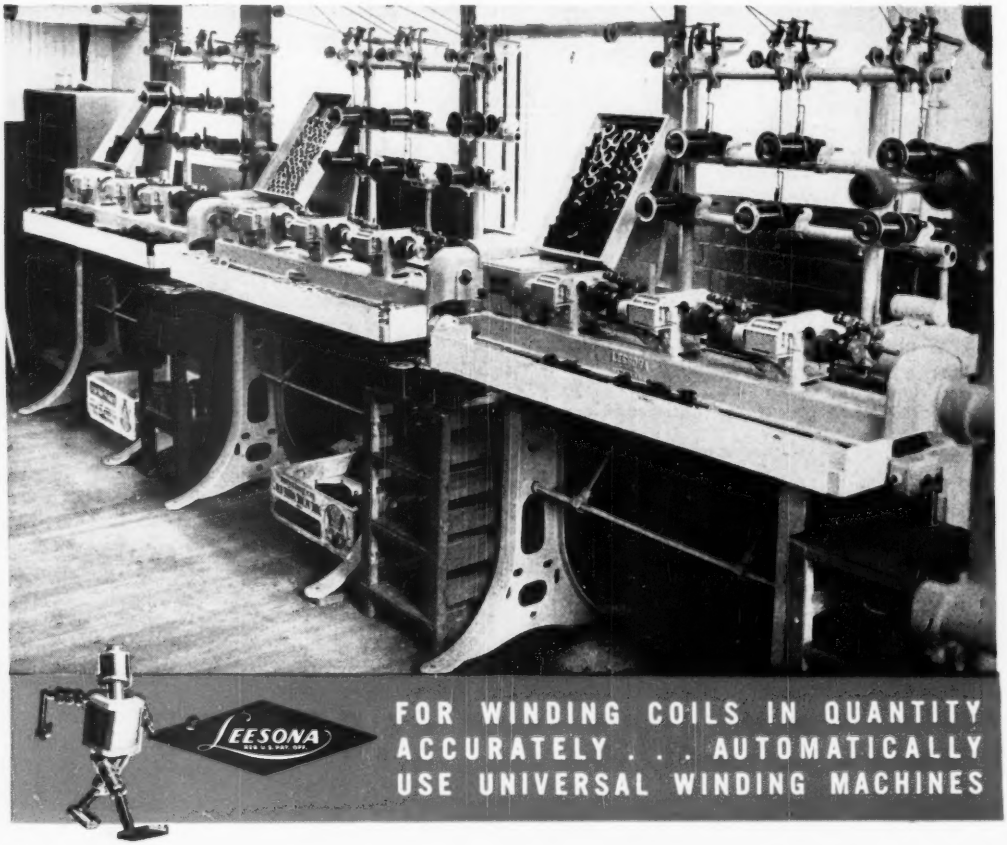
Relay coils, ringer coils and switch coils are other bobbin-type coils wound on this machine which permits synchronization of winding time on the various heads with handling time per coil.

Coil size is accurately controlled by an electrically-operated counter which automatically stops each head upon completion of the coil. Steel-strap control of tension makes it possible to handle even the finest wires.

Other Universal Coil Winders in this plant are the No. 104 which winds paper-insulated coils and the No. 96 which winds cotton-interwoven coils for business machines.

Write for bulletins on Universal Coil Winders —No. 84, lattice-type; No. 96, layer-wound; No. 98, gutter-wound; No. 102, spool-wound, non-insulated; Nos. 104 and 105 paper-insulated, in stick form.

UNIVERSAL WINDING COMPANY, Dept. L, P. O. Box 1605, Providence 1, R. I.



37% GREATER EFFECTIVENESS

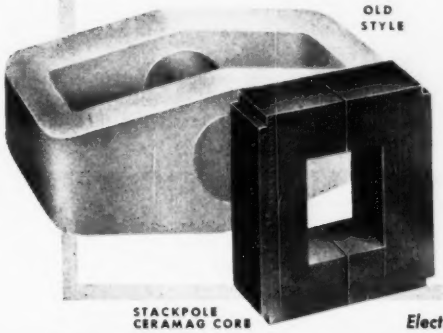
in Television image

W-I-D-T-H CONTROL

. . . and many times the permeability in half the size

FOR TV FLYBACK TRANSFORMER CORES

Permeability on the order of 10 to 1 by comparison with conventional iron cores for flyback transformer applications, is readily possible with the new Stackpole Ceramag types. In addition, Ceramag cores are much smaller, have higher resistance, operate cooler due to absence of eddy current losses.



STACKPOLE CERAMAG CORE

Molded of a unique powdered material having exceptionally high permeability, Stackpole Ceramag iron cores bring a new, higher standard of efficiency to television horizontal image deflection circuits. In screen areas where there is a sudden voltage drop, Ceramag cores give ratios of from 1 to 8 or more compared with 1-5 for previous high permeability types. Complete details or samples to match your requirements sent on request.

STACKPOLE *Ceramag*®

HIGH PERMEABILITY *Cores*

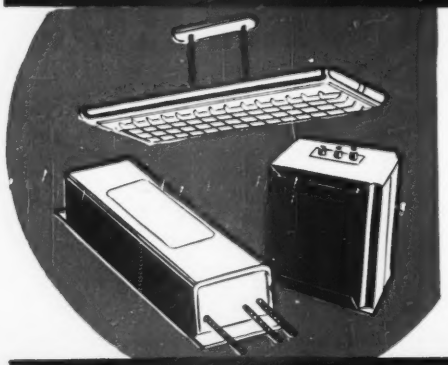
Electronic Components Division

STACKPOLE CARBON COMPANY • ST. MARYS, PENNA.

MITCHELL-RAND DOES IT AGAIN!

PRODUCES SEALING COMPOUND 1820EX FOR FLUORESCENT BALLASTS AND GENERAL TRANSFORMER USE

with greater thermal conductivity; containing half the conventional amount of filler; having the normal in cushioning effect and **AT LOWER PRICE** than is being charged for less effective sealing compounds used for ballasts and transformers



READ THESE SPECIFICATIONS AND WRITE FOR YOUR FREE SAMPLE OF 1820EX . . . ten gallons will be sent for your tests and comparison . . . you'll agree 1820EX is better than any ballast and general transformer compound now available . . . and at lower cost, too!

S.P. (R&B)	— 235/245 F
PENETRATIONS	
32 200 60	— 14
77 100 5	— 18
115 50 5	— 26
SPECIFIC GRAVITY	— 1.143
POUR TEMP.	— 400 F
FLASH POINT	— 480 F
FIRE POINT	— 540 F
DUCTILITY AT 77° F	— 2.0

NOTE THE RESULTS OF THERMAL CONDUCTIVITY TESTS CONDUCTED BY TESTING LABORATORIES

The pothead compound, No. 1820, was tested for thermal conductivity on a modified form of the guarded hot plate apparatus described in A.S.T.M. Standard C-177.

Thickness Inches	Mean Temperature	Thermal Conductivity BTU/hr/sq. ft./°F/inch
1.0	160°F	1.78

Yes, MITCHELL-RAND DOES IT AGAIN . . . produces 1820EX, a sealing compound, for fluorescent ballasts and general transformers, with greater thermal conductivity; containing half the conventional amount of filler, having the normal in cushioning effect, and at a lower price than is being charged for less effective sealing compounds used for ballasts and transformers.

You can rely upon Mitchell-Rand for compounds and waxes to meet your specific requirements, and should the need arise for a special formula to meet a particular condition, then Mitchell-Rand will create the compound embodying every quality required.

Mitchell-Rand has more than 3500 compound and wax formulas to resist high voltage breakdown, salt spray atmosphere, humidity, cracking or flaking, acids and alkalis. They have excellent flexibility and adhesive qualities, high cold flow and good thermal conductivity. Mitchell-Rand waxes penetrate fibre, floss, bakelite, paper and cloth. They have low viscosity, high surface tension and good electrical characteristics.

MITCHELL-RAND INSULATION CO. Inc.

51 MURRAY STREET • COrtlandt 7-9264 • NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATED VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING

MUDDLING in High Places

It is time for men in Washington and London to stop toying with the problem of international trade. We of the democratic West are at a turning point in our economic affairs. A false step by either the United States or Britain could lead quickly to disintegration of trading between the people of the world as we have known it for the past hundred years. Recent meetings of diplomats in London and Washington have not lifted us out of this danger.

By two simple tests you and I can measure the sincerity of the men in Washington and in London who are trying to solve what they call "the dollar crisis."

One test applies to the British: Is Britain making an honest effort to re-establish itself as a real competitor in world markets?

The other test applies to us in the United States: Are we willing to see Britain re-emerge as a strong competitor in world markets—even in our own home market—and to help her do so?

Today, even though both countries have faced the devaluation test, the answer to these questions probably is no.

I

The situation we face is, in fact, unprecedented. In every important industrial country of the non-Communist world, except Germany and Japan, production is above prewar volume, thanks largely to the Marshall Plan. Yet trade between nations is shackled as it has never been since the 18th century. And the shackles grow day by day. What is worse, two distinct trading areas—the dollar area and the sterling area—have grown up in the non-Communist world, and the gulf between them grows wider.

What kind of leadership have the United States and Britain had in the face of this crisis? President Truman late in August wisely checked the trans-Atlantic bickering over the dollar crisis. *But Mr. Truman showed no awareness of the basic question that the American people must soon decide: Is the United States able and willing to generate trade between nations, as Britain did in the 19th century?*

What have British leaders offered us? Foreign Secretary Bevin and Chancellor Cripps called their September visit to Washington "one of the most important missions in history." *But they did not tell the British people, and perhaps do not admit themselves, that their Labor government must change its internal and external policies if Britain is ever to earn its living in a competitive world.*

Admittedly, the problem Britain has faced since 1945 is a colossal one. But, in the face of its grave difficulties, what has Britain done? The working day was shortened. Welfare economics have run riot. High taxes have sapped incentives. Labor and capital have clung to their prewar psychology of cartels and featherbedding. Government controls and government trading have hamstrung private initiative. Nationalization schemes have injected politics into the struggle for industrial recovery.

Thus the policies of the Labor government have made Britain's adjustment to its new position in the world immensely more difficult. But Americans who attribute the danger of an international breakdown to British socialism greatly oversimplify the problem. Virtually every country in the world, socialist or not, faces the same dollar crisis that Britain faces.

continued on next page

We Americans must recognize that our economic strength unbalances world trade as does Britain's weakness. World War II increased America's superior power to produce goods. It also made the United States more self-sufficient. Thus, while the world demand for American goods has risen, our demand for foreign goods, except for basic raw materials, has not increased. Today we sell more to every major area of the world than we buy from it—and yet we wonder why there is a dollar crisis.

It is time for us to recognize that there are two fundamentally conflicting pressures at work in the United States. One is our desire for a big surplus of exports over imports. The other is our desire for a system of free-wheeling trade around the world. We can not have both unless we as taxpayers wish to subsidize our exports. Which do we want?

Curtis E. Calder, chairman of the International Relations Committee of the National Association of Manufacturers, says, "The battle of the foreign trade gap is essentially that of reconciling our urge to export our surpluses with a reluctance to accept imports in payment for them . . . The dilemma is an uncomfortable one to face."

II

Here, then, are the basic questions that confront men in Washington and London. Does Britain really want expanding world trade or a high-cost welfare state? Does the United States really want expanding world trade or a huge surplus of exports? So far politicians in Washington and especially in London have ducked these issues because they are political dynamite.

If the people of Britain decide they want to regain their position as a competitive trader in expanding world markets, here are specific objectives that men in London should set for themselves:

1. Lower government costs. The British Treasury has asked for cuts of 5% in 1950. But a cut nearer 15% will be necessary, even if that means fewer government subsidies and health services. Enterprise will never revive nor costs come down while taxes take 40% of the British national income, including roughly 60% of business profits.

2. Fewer government controls. Only by removing controls and allocations (except on a few necessities) can Britain begin to return to prices fixed by competition rather than by government fiat.

3. Stronger anti-monopoly legislation for both business and labor. Britain needs a concerted drive against all forms of restrictive, high-cost practices. This drive should put teeth in the anti-monopoly act and supplement it with legislation to end restrictions imposed by trade unions.

4. Less restrictive trading practices. Britain should retreat gradually from its international barter between governments if competition is ever to have free play in international trade.

Meanwhile, if we of the United States sincerely want multilateral world trade, men in Washington must face up to four problems and hammer out workable solutions:

1. Use of the International Monetary Fund to back a devalued pound. In time the Fund, in which we have the controlling voice, might be used to promote convertibility of pounds into dollars.

2. Help for Britain in meeting war-created external debts. This might mean support for London in getting a reduction of the war debts Britain owes India, Pakistan and Egypt, for example. To achieve such a debt reduction for Britain we might have to underwrite a part of a Southeast Asia recovery program.

3. Encouragement of American investments abroad. Such investments should be directed primarily into enterprises which will earn dollars, such as the development of new sources of raw materials, or which will raise productivity abroad.

4. Our own tariff barriers. Our attitude toward this critical issue will be the acid test of how deeply we believe in the merits of free world competition.

If we really want free, competitive trading between the people of the world, these issues must be met and resolved by leaders on both sides of the Atlantic. If we do not want to face these issues, then let us resign ourselves to a world walled off into three trading areas: the Communist bloc, the sterling area, and the dollar area. So far, Washington and London have muddled along, except in facing the devaluation problem. Clarity and courage are still needed.

President, McGraw-Hill Publishing Company, Inc.

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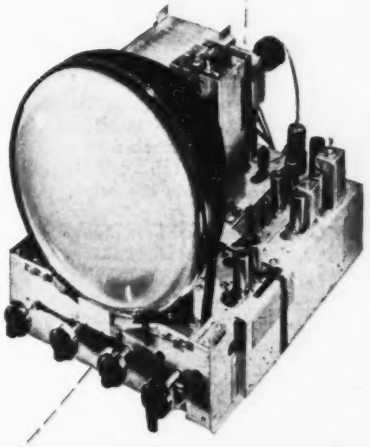

Admiral Model 20A1 Television Chassis uses numerous **HI-Q** Components to contribute to its dependable performance and long life.

HI-Q COMPONENTS

BETTER 4 WAYS

PRECISION Tested step by step from raw material to finished product. Accuracy guaranteed to your specified tolerance.

UNIFORMITY Constancy of quality is maintained over entire production through continuous manufacturing controls.

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REVERE FREE-CUTTING COPPER ROD
. . . INCREASES ELECTRONIC PRODUCTION

SINCE its introduction, Revere Free-Cutting Copper has decisively proved its great value for the precision manufacture of copper parts. Uses include certain tube elements requiring both great dimensional precision, and exceptional finish. It is also being used for switch gear, high-capacity plug connectors and in similar applications requiring copper to be machined with great accuracy and smoothness. This copper may also be cold-upset to a considerable deformation, and may be hot forged.

Revere Free-Cutting Copper is oxygen-free, high conductivity, and contains a small amount of tellurium, which, plus special processing in the Revere mills, greatly increases machining speeds, makes possible closer tolerances and much smoother finish. Thus production is increased, costs are cut, rejects lessened. The material's one important limitation is that it does not make a vacuum-tight seal with glass. In all other electronic applications this special-quality material offers great advantages. Write Revere for details.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue
New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere.

CUSTOMERS REPORT:

"This material seems to machine much better than our previous hard copper bar; it cuts off smoothly, takes a very nice thread, and does not clog the die." (Electrical parts.)

"Increased feed from 1-1/2" to 6" per minute and do five at one time instead of two." (Switch parts.)

"Spindle speed increased from 924 to 1161 RPM and feed from .0065" to .0105" per spindle revolution. This resulted in a decrease in the time required to produce the part from .0063 hours to .0036 hours. Material was capable of faster machine speeds but machine was turning over at its maximum. Chips cleared tools freely, operator did not have to remove by hand." (Disconnect studs.)

SWIFT, SURE FREQUENCY COMPARISON

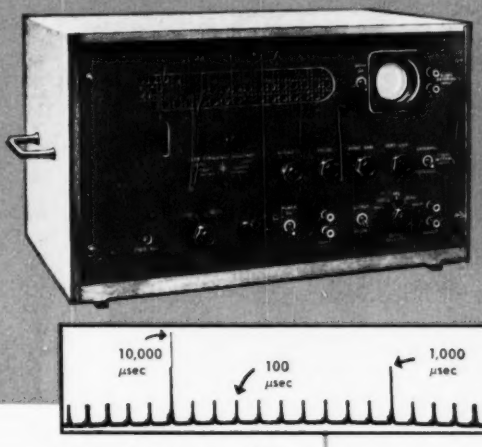

FIG. 1. Timing Comb, -hp- Model 100D

NEW hp SECONDARY FREQUENCY STANDARDS

MODELS 100C AND 100D

- Sine or rectangular waves
- 100 μsec time markers
- Built-in oscilloscope
- Stability 1/1,000,000
- Low output impedance
- New, improved circuits
- Audio, supersonic, rf measurements

SPECIFICATIONS

-hp- 100D Secondary Frequency Standard

Accuracy:
About 2 parts per million per week, normal room temperature.

Stability:
About 1 part per million over short intervals.

Output:
Controlled frequencies: 100 kc, 10 kc, 1 kc, 100 cps, 10 cps. Sine or rectangular waves; marker pips. Internal impedance approx. 200 ohms.

Wave Shape:
Sine wave: less than 4% distortion into 5,000 ohms or higher load.

Marker Pips:
10,000, 1,000 and 100 μsec intervals.

Oscilloscope:
Integral with circuit. Establishes 10:1 Lisajous figures to show division ratio. May be used independently of standard.

-hp- 100C Secondary Frequency Standard

Accuracy:
Within ± .001% normal room temperature.

Output:
Controlled frequencies of 100 kc, 10 kc, 1 kc, and 100 cps. Internal impedance approx. 200 ohms.

Wave Shape:
Sinusoidal only. 4% distortion into 5,000 ohm load.

Power Supply:
(100C and 100D) 115 v, 50/60 cps, regulated to minimize line voltage fluctuations. Power drawn approx. 150 watts.

Mounting:
(100C and 100D) Cabinet or relay rack. Panel 19" x 10½". 12" deep.

Data Subject to Change Without Notice

The new *-hp-* 100C and 100D Secondary Frequency Standards incorporate all the features of the time-tested *-hp-* models 100A and 100B, plus important new advantages including rectangular wave output, timing pips, and an internal oscilloscope for convenient frequency comparison. The *-hp-* 100D may be conveniently standardized against station WWV with a minimum of external equipment, and thus provide most of the advantages of an expensive primary standard.

Crystal Controlled Frequencies

The new *-hp-* Models 100D and 100C employ a crystal-controlled oscillator and divider circuits offering a new high in stability and simplicity of operation. Standard frequencies are available through a panel selector switch, and may be employed simultaneously. Internal impedance is low (about 200 ohms), so that standard frequencies can be delivered at some distance from the instrument.

The *-hp-* 100D Secondary Frequency Standard offers sine waves at 5 frequencies and rectangular waves at 4 frequencies, plus a built-in oscilloscope. The instrument also provides a timing comb with markers 100, 1,000 and 10,000 microsecond intervals. Rectangular wave output has a rise time of approximately 5 microseconds. Accuracy is 2 parts per million.

5 v. at all Frequencies

The more moderately priced *-hp-* 100C Standard offers sinusoidal frequencies at 4 crystal-controlled frequencies and, like the *-hp-* 100D, provides 5 volts of output at all frequencies. Accuracy .001%.

Both models operate from a 115 v. ac power supply, and power is regulated to minimize power line voltage fluctuations.

Get full details . . . see your -hp- representative or write direct . . . today!

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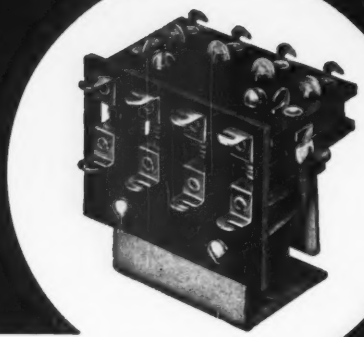
FOR SPEED AND ACCURACY

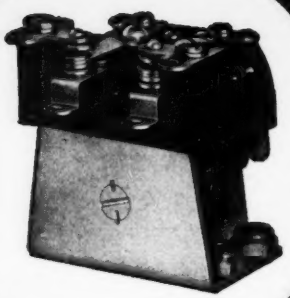
These Three

ALLIED POWER RELAYS

FROM SINGLE-POLE TO FOUR-POLE

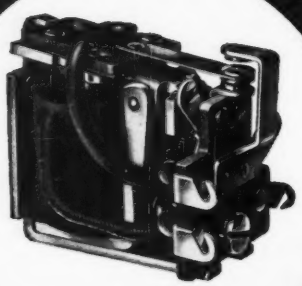
TYPIFY ALLIED VERSATILITY





3-POLE & 4-POLE "PO" TYPE RELAY

This medium power relay is supplied with contact arrangements up to 4-pole double-throw. Standard silver contacts rated at 15 amperes for 24 volts DC or 110 volts AC non-inductive. Coil rating 2.5 watts up to 112 volts DC and 10.5 volt-amperes up to 230 volts AC. Dimensions: 3-pole 2-1/4" x 1-7/8" x 1-5/8". 4-pole 2-1/4" x 1-7/8" x 2-3/16".



SINGLE-POLE "AS" TYPE RELAY

This small, light-weight power relay is supplied with single or double-throw contacts. Standard silver contacts rated at 5 amperes for 24 volts DC or 110 volts AC non-inductive. Coil rating 1 watt up to 95 volts DC and 3.5 volt-amperes up to 230 volts AC. Dimensions: 1-3/8" x 1-5/8" x 15/16".

DOUBLE-POLE "BO" TYPE RELAY

This all-purpose power relay is supplied with single or double-throw contacts. Molded insulation throughout. Standard silver contacts rated at 15 amperes for 24 volts DC or 110 volts AC non-inductive. Coil rating of 2.5 watts up to 112 volts DC and 4.5 volt-amperes up to 250 volts AC. Dimensions: 1-7/8" x 1-13/32" x 1-5/8".

Like all Allied Relays, types "AS," "BO" and "PO" may be had hermetically sealed, with choice of standard octal plug-in base or solder-type terminals.

For complete information on these and other Allied Relays, write for latest Bulletin.

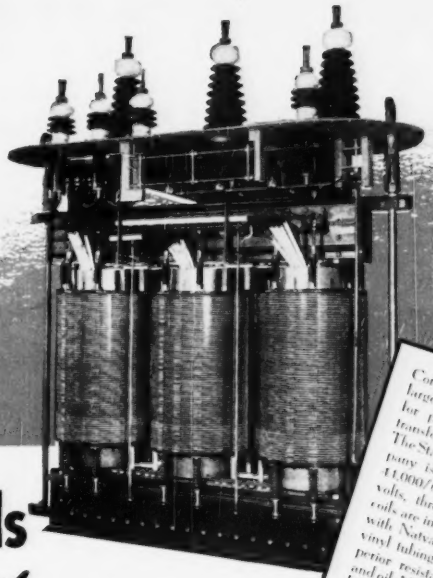
NEW RELAY GUIDE

This new folder shows 24 small, compact Allied Relays with a carefully detailed table of characteristics and specifications. Write for YOUR free copy today.

ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, NEW YORK

The Standard Transformer Company Insulates and Protects Transformer Leads and Coils *with* NATVAR 400

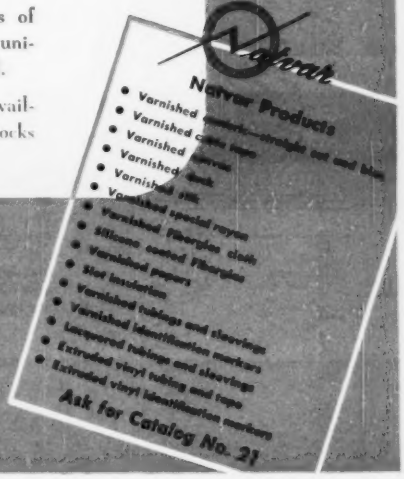


Core and coil assembly of a large power transformer ready for placing in its tank. This transformer, manufactured by The Standard Transformer Company is rated at 5000 KVA, 44,000/66,000 to 7575/16,000 volts, three phase. Leads and coils are insulated and protected with Natvar 400, the extruded vinyl tubing and tape with superior resistance to both heat and oil. Natvar Varnished Cambric and Natvar Cable Tape are also used in Standard transformers.

The Standard Transformer Company, Warren, Ohio, uses only high grade insulating materials in the transformers they build because they know how much these materials contribute to their performance —their long life, dependability, and surge proof qualities.

Natvar 400, approved for continuous operating temperatures of 105°C., gives lasting insulation and protection because of its uniformly superior resistance both to high temperatures and to oil.

Natvar 400 and other Natvar flexible electrical insulations are available for immediate delivery, either from your wholesaler's stocks or from our own.



THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE RAHWAY 7-2171 — CABLE ADDRESS NATVAR: RAHWAY, N. J.

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ELECTRONICS

Designers

A LINE-VOLTAGE STABILIZER

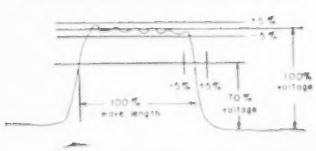
SO SMALL . . .

. . . it mounts on a radio chassis

These 15-, 25-, and 50-va G-E voltage-stabilizer units are only a little over 2 inches high and about 9 inches long. They'll mount easily on a medium-sized radio or electronic instrument chassis and will give you an even, non-fluctuating 115 volts for your equipment whether your line voltage is 95 or 130. A special transformer circuit provides a stabilized output voltage within 1% of 115 volts for fixed, unity-power-factor loads.

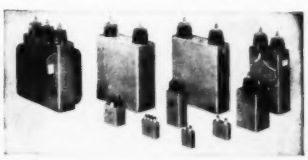
Continuous operation under conditions of short or open circuits will not damage the stabilizer in any way. Since there are no moving parts, there is little maintenance to worry about. For complete information on voltage-stabilizer units of all sizes from 15-va to 5000-va, write for Bulletin GEA-3634.

AN EASY WAY TO PRODUCE SQUARE WAVES



Specially designed G-E Type-E networks will produce impulses which have definite, known energy contents and durations, and thus are ideal for converting a-c or d-c charging voltages into approximately rectangular square waves. These networks consist of capacitor and coil sections adjusted to close tolerances and hermetically sealed in single metal containers.

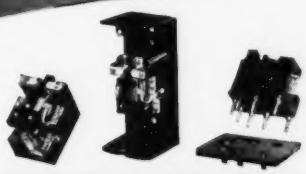
G.E. helped meet wartime radar demands with thousands of these units and now offers them for commercial use. They are available in a wide range of designs, impedances, ratings, and sizes for pulse lengths of 0.1 to 40 microseconds. See Bulletin GEA-4996.



GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS



HEAVY-DUTY RELAYS THAT MOUNT 3 WAYS

This versatile, general-purpose, heavy-duty, a-c relay unit is available in three mounting arrangements: front connected, back connected, or plug-in connected. All three mounting types are available in open or enclosed models and are furnished in spst, dpst, or dpdt circuits. Heavy, long-lasting silver contacts carry 10 amps continuous. Normally-open forms make or break 45 amps; normally-closed forms make or break 20 amps. Relay coils come in 12-, 24-, 115-, or 230-volt, 60-cycle a-c sizes. D-c units are available in similar models. For full details see GEC-257.

ACCURATE BUT RUGGED

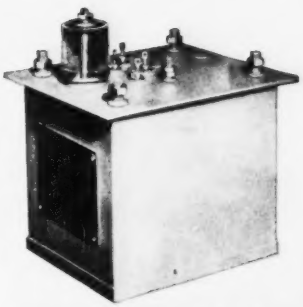
The new, modern-looking, easy-to-read 2½ inch G-E instrument line is improved inside as well as outside. A single, self-contained mechanism supported on an extremely strong Alnico magnet assures permanent alignment even under the most adverse operating conditions. This high-gauss Alnico magnet permits the use of a large air gap with a consequent smoother, non-sticking action. The greater torque-to-weight ratio means better damping and allows the use of heavier vibration-resisting pivots. Accuracy is 5% of full scale on rectifier types, 2% on all others. For complete details, send for Bulletin GEC-368.

SNAP-SWITCH INSTALLATION TIME CUT TO SECONDS

You'll have a firm electrical connection without the use of solder a few seconds after you begin to install this small but rugged Switchette. Only 1½ inches long and weighing only 9 grams, this 230-vac, 10-amp unit has solderless knife-contact terminals made of pure, tinned copper.

G-E Switchettes are available in a variety of forms and circuits, all of which have double-break contact structures. They're particularly well suited for electronic applications because of their low RF noise output (short contact-bounce).

For your convenience there are screw-terminal and soldering-lug types as well as this special quick-connect unit. Send for Bulletin GEA-4888.



A SMALL PACKAGE OF WELL-REGULATED HIGH VOLTAGE

You get both high voltage and good regulation with small lightweight G-E precision rectifiers. This may interest you if you need compact, well-regulated, high d-c voltage sources for cathode-ray tubes, television camera tubes, radar indicator scopes, electron microscopes, Geiger-Mueller counters, or similar jobs.

These supplies are hermetically sealed and oil-filled. Typical units have outputs of 7 kv at 0.1 ma.—have only 3.5% deviation for every 0.1 ma load and output ripple of less than 1%. Size—only 6" x 6" x 7". Weight—8 lbs. For further data, write: General Electric Company, Section 667-3, Schenectady 5, N. Y., giving complete information on the proposed application with specifications required.

General Electric Company, Section C667-3
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

- ☐ GEA-3634 Voltage stabilizers
- ☐ GEA-4888 Switchettes
- ☐ GEA-4996 Capacitor networks
- ☐ GEC-257 Heavy-duty relays
- ☐ GEC-368 Instruments

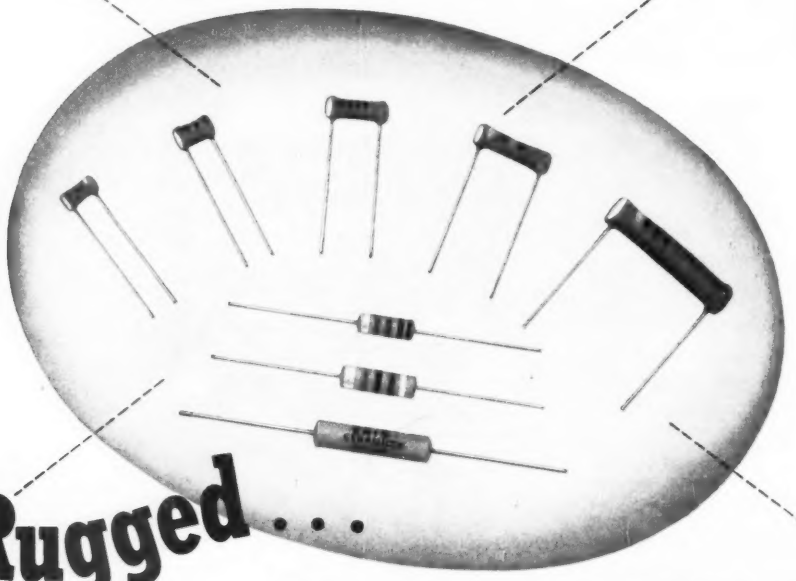
NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

ERIE "GP" CERAMICONS



Rugged . . .

DO NOT BREAK IN ASSEMBLY—SERVICE

Erie General Purpose Ceramicons became favorites in the industry when TV sets were still a negligible part of total output. The qualities which recommended them for by-passing and coupling applications which were not frequency determining in radio receiving sets, become even more important in television assembly.

Erie "GP" Ceramicons are rugged and compact. Tubular form and phenolic insulation provide extra sturdiness that withstands rough handling both in installation and in service.

General Purpose Ceramic Condensers are economical because, by limiting them to definite capacity values, they can be manufactured in quantity without sacrifice of quality.

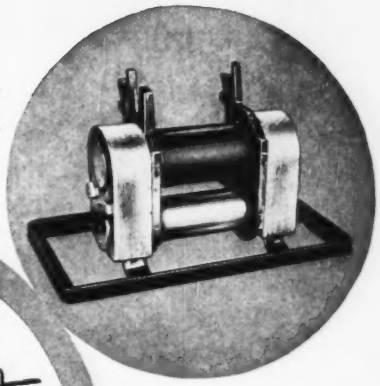
They are made in insulated and non-insulated styles, in popular capacity values up to 10,000 MMF. Write for detailed information and samples.

Electronics Division

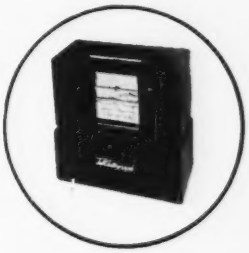
ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

View of Magnet Assembly: Top bar Crucible Alnico; lower bar (replacing former 2nd magnet) provides return path and reinforces assembly.



Crucible cuts magnet costs in half!



TelAutograph Corporation, New York, N. Y., designs and manufactures the TelAutograph telescriber, an instrument that transmits handwritten messages over wire to one or many remotely located receivers.

Receiver operation is similar to a d-c voltmeter: the motion and position of the recording pen is determined by the force developed in a coil that is free to move in a fixed magnetic field. Originally this field was produced by current through a wound coil, but this generated heat and reduced the field strength. Permanent magnets were substituted for the coil. But here a problem arose:

Two permanent magnets were required to match the electromagnetic field. This made assembly time and unit costs excessive. Crucible Magnet Specialists were called in, and in short order developed one permanent magnet to replace the two. This resulted in a 50% magnet cost cut, improved mechanical construction and a general reduction in assembly cost . . . *plus* increased unit efficiency.

That's how TelAutograph Corporation made good use of Crucible's half-century of specialty steel experience. Your problems will be given the same careful attention. Please state your permanent magnet application when you write.

CRUCIBLE STEEL COMPANY OF AMERICA
405 LEXINGTON AVE., NEW YORK 17, N. Y.
Branches: Warehouses and Distributors in Principal Cities

CRUCIBLE first name in special purpose steels

PERMANENT ALNICO MAGNETS

STAINLESS • HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS

NEW ALTITUDE RECORDS in assembly and sales...

...both are "jet-assisted" by AMERICAN PHILLIPS SCREWS

NEW ALTITUDE MARKS IN ASSEMBLY: Savings zoom skyward when American Phillips Screws take over the cost-controls in any assembly operation. *Time-savings alone climb as high as 50%* . . . over old-fashioned, slowpoke, fumble-and-fume slotted screws! Meanwhile spoilage and rejects . . . yes, and lost-time accidents, too . . . are grounded once and for all.

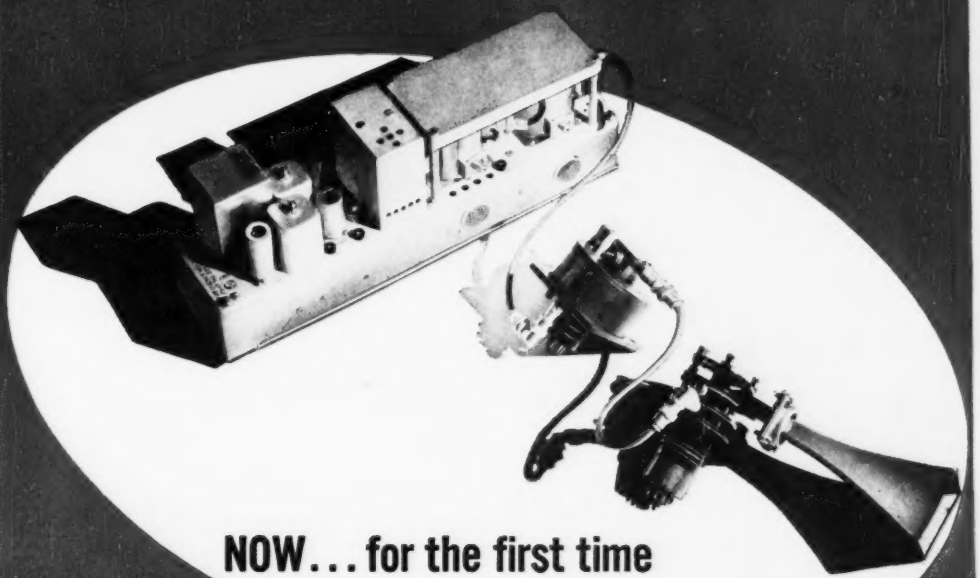
NEW ALTITUDE MARKS IN SALES: Next time you board a commercial airliner . . . or *any* plane, for that matter . . . look around you and see what the aviation industry thinks of American Phillips Screws. *They use almost nothing else but!* And aside from the assembly savings and the vibration-proof fastenings, there's another customer-consideration in there, also . . . because there's never a burr on a Phillips head to snag clothes or scratch hands. Buyers of everything from airplanes to zithers, what's more, are coming to recognize *and look for* the American Phillips crossed recess as a sure surface index of inbuilt quality in *any* product. Does *yours* have this sales advantage? Just write:

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois St. Norristown, Pa. *Detroit 2* 502 Stephenson Bldg.

AMERICAN PHILLIPS *Screws*

ALL TYPES
ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)



NOW... for the first time

SUBSTANTIAL POWER

At Microwave Frequencies with Direct Crystal Control

Now, with two new Sperry Klystron tubes, stabilized frequency control is possible at 10,000 mc. with 1 watt continuous wave power output. These multiplier tubes, the SMC-11 and the SMX-32, permit direct crystal control at microwave frequencies with this power level.

Starting with a 5 mc. crystal, the frequency is multiplied to 830 mc. by use of an *Exciter*. The SMC-11 Klystron multiplies the 830 mc. to a frequency of 5,000 mc. The SMX-32 then multiplies this frequency to 10,000 mc. with the same accuracy which exists in the control crystal (±0.0005%).

This practical achievement of 1 watt power output with continuous accuracy of frequency control at 10,000 mc. exists only through the use of these two Sperry Klystrons.

Write our Industrial Department for further information.

SPERRY

GYROSCOPE COMPANY

DIVISION OF THE SPERRY CORPORATION
GREAT NECK, NEW YORK

NEW YORK • CLEVELAND • NEW ORLEANS
LOS ANGELES • SAN FRANCISCO • SEATTLE

1949 IS TV YEAR

Here are some of the many reasons why there are more Simpson 260 high sensitivity volt-ohm-milliammeters in use today than all others combined. The Simpson 260 has earned world-wide acceptance because it was the first tester of its kind with all these "Firsts":

Simpson 260 SET TESTER

WORLD FAMOUS FOR ALL THESE "FIRSTS"

- First high sensitivity instrument to use a metal armature frame.
- First to use fully enclosed dust proof rotary switch with all contacts molded in place accurately and firmly.
- First to do away with harness wiring.
- First to provide separate molded recesses for resistors, batteries, etc.
- First to cover all resistors to prevent shorts and accidental damage and to protect against dust and dirt.
- First with a sturdy movement adapted to the rugged requirements of a wide range of service work or laboratory testing.
- First to provide easy means of replacing batteries.
- First to use all bakelite case and panels in volt-ohm-milliammeters.
- First volt-ohm-milliammeter at 20,000 ohms per volt with large 4½" meter supplied in compact case (size 5¼" x 7" x 3⅛").
- First and only one available with Simpson patented Roll Top Case.
- First to provide convenient compartment for test leads (Roll Top case).
- First to offer choice of colors.

RANGES

20,000 Ohms per Volt DC, 1,000 Ohms per Volt AC

VOLTS: AC & DC—2.5, 10, 50, 250, 1,000, 5,000

OUTPUT: 2.5, 10, 50, 250, 1000

MILLIAMPERES, DC: 10, 100, 500

MICROAMPERES, DC: 100

AMPERES, DC: 10

DECIBELS: (5 ranges)—12 to +55 DB

OHMS: 0-2,000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center).

Prices: *$38.95 dealers net; Roll Top $45.95 dealers net.*

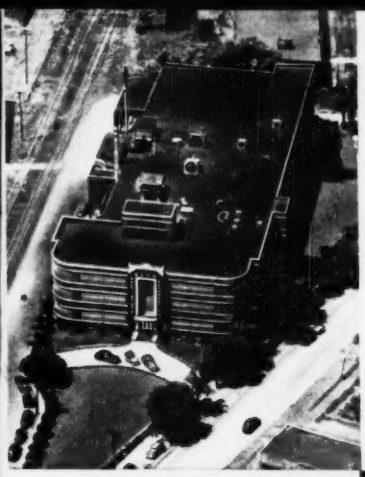
Simpson

INSTRUMENTS THAT STAY ACCURATE

The Model 260 also is available in the famous patented Roll Top safety case with built-in lead compartment. This sturdy, molded, bakelite case with Roll Top provides maximum protection for your 260 when used for servicing in the field or shop.

25,000 volt DC Probe for television servicing, complete, for use with 260, $12.85

SIMPSON ELECTRIC COMPANY • 5200-18 W. Kinzie St., Chicago 44, Ill. • *In Canada: Bach-Simpson, Ltd., London, Ont.*



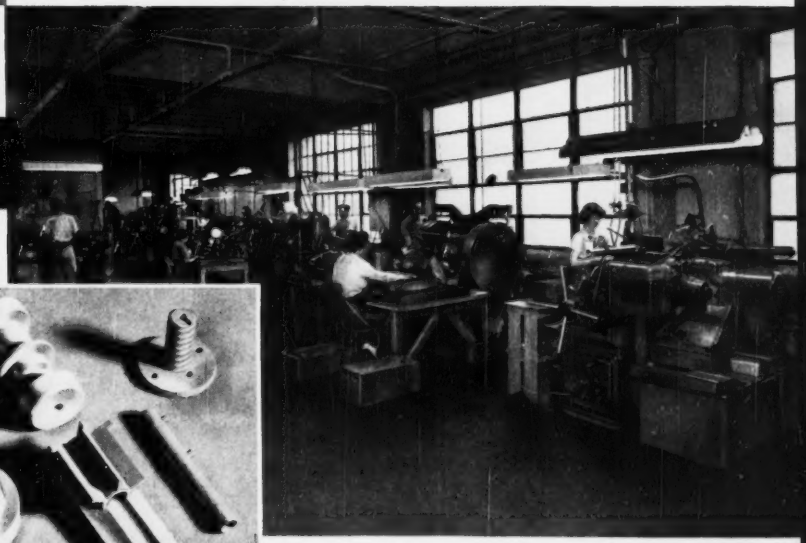
grinding

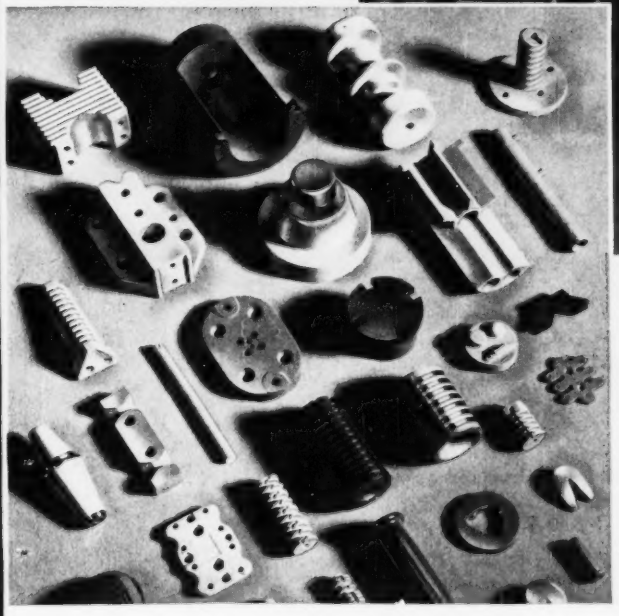
by skilled operators

enables AlSiMag to meet

unusual dimensional tolerances

AlSiMag
Reg. U. S. Pat. Off.





After firing, AlSiMag is extremely hard. Further finishing requires special tools, great skill. We have the tools and the skill and can meet almost any tolerance required. The closer tolerances involve commensurate cost. Even if you think your requirements are impossible, ask us. It is probable that we can solve your problem . . . well within practical cost limits. Ability to consistently comply with dimensional and physical requirements is another reason why American Lava Corporation is known as Headquarters for Custom Made Technical Ceramics.

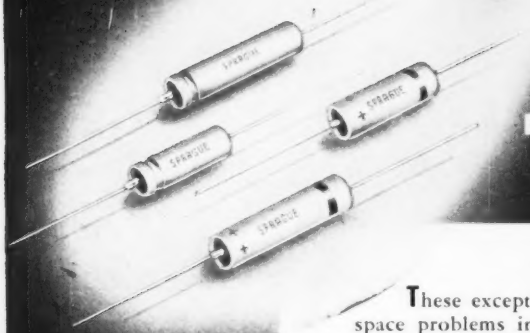
AMERICAN LAVA CORPORATION

48TH YEAR OF CERAMIC LEADERSHIP

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • CHICAGO, 9 South Clinton St., Central 6-1721
PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823 • LOS ANGELES, 232 South Hill St., Mutual 9076
NEW ENGLAND, 38-B Brattle St., Cambridge, Mass., Kirkland 7-4498 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

SPACE SAVERS *de luxe*



SPRAGUE
MINIATURE
DRY ELECTROLYTICS
Types 16D and 18D

Write for Sprague Engineering Bulletin No. 303 for complete details.

These exceptionally small capacitors really solve space problems in miniaturized electronic and radio equipment. And their performance characteristics actually surpass those of ordinary metal encased tubular dry electrolytic capacitors!

Sealed against moisture, Types 16D and 18D electrolytics are normally furnished for operation at 85° C. to meet the high operating temperatures common in crowded assemblies. Type 18D has an outer insulating tube over the metal case, whereas Type 16D does not have this extra covering.

SPRAGUE

SPRAGUE ELECTRIC COMPANY
North Adams, Mass.

PIONEERS IN
ELECTRIC AND ELECTRONIC DEVELOPMENT

FOR a direct-viewing 203 square-inch picture

FOR superlative brilliance and definition

FOR shorter tube length requiring smaller cabinet

FOR exclusive bent-gun construction – sharper focus – no ion-spots

© Allen B. Du Mont Laboratories, Inc.

Literature and quotations on request.

*Trade-mark.

DUMONT

FIRST WITH THE FINEST IN T-V TUBES

Teletrons

ALLEN B. DU MONT LABORATORIES, INC. • TUBE DIVISION • PASSAIC, NEW JERSEY

STAY AHEAD IN CHOOSE

CHARACTERISTICS
TYPE 16GP4

Max bulb diameter	16 inches
Min useful screen diameter	14⅝ inches
Heater voltage	6.3 v
Heater current	0.6 amp
Focusing method	magnetic
Deflecting method	magnetic
Deflecting angle (approx)	70 degrees
Screen fluorescent color	white
Over-all length	17 15/16 inches (max)
Bulb contact	metal-cone lip
Base	small-shell duodecal 5-pin

Max ratings, design-center values

Anode voltage	14,000 v
Grid No. 2, voltage	410 v
Grid No. 1, voltage	—125 v

Typical operating conditions

Anode voltage	12,000 v
Grid No. 2, voltage	300 v
Grid No. 1, voltage for cut-off	—55 v

TYPE 16GP4

16-inch metal picture tube, with wide-angle (70-degree) sweep, and high-contrast-glass face. Designed for modern receivers where size of the cabinet is restricted, yet the picture must be large, clear, and sharp. . . . Tube is less than 18 inches long; its weight is approximately half that of an all-glass type. . . . Generous picture area is 163 sq. inches when the entire tube face is scanned; 132.5 sq. inches when standard raster of 3-by-4 aspect is employed. . . . Special high-contrast-glass face helps produce a clear image with superior definition.

TELEVISION! GENERAL ELECTRIC TUBES!

LEAD, or be left behind! Designers and builders of TV receivers face that challenge. By specifying General Electric tubes, you (1) help assure the over-all advanced design of your product, and (2) make a popular move to meet the demand of buyers for what's newest and best in television home equipment.

Progress shows, for example, in every characteristic of G.E.'s new 16-inch wide-angle picture tube. Because of its comparatively short length, you can design a receiver about Type 16GP4 that will fit conveniently into the average small living-room. At the same time, the picture area is large, giving excellent visibility for a good-sized group of guests. The face of the tube is a special new dark-tone glass providing high contrast . . . images show more clearly, with sharper definition.

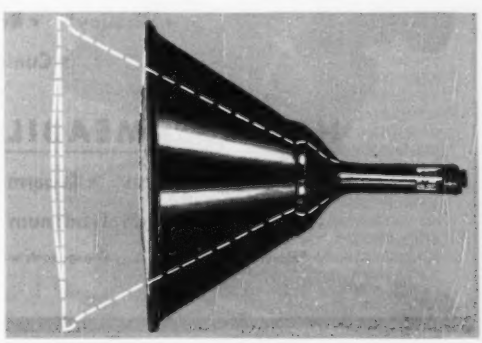
G-E receiving tubes of advanced design spell progress and economy. The new 6BN6, a miniature gated-beam tube, functions as a limiter, discriminator, and audio-amplifier in TV and FM receivers, thereby replacing 3 tubes and associated components.

Other G-E picture tubes—Types 8AP4, 10BP4, 10FP4, 12KP4 and 12LP4—share in the advancements being recorded by General Electric's continuous research in television. And a full line of G-E receiving-type tubes is available, including such outstanding new designs for television use as the 6AB4, 6BN6, 12AT7, 12AU7, and 12AY7.

Choose General Electric tubes to make sure the product you design, build, and sell is in the forefront competitively! Experienced G-E tube engineers will be glad to work with you in selecting the right types for your circuit. Wire or write today to *General Electric Company, Electronics Department, Schenectady 5, New York.*

SHORTER—MAKES POSSIBLE A MORE COMPACT TV RECEIVER

Why Type 16GP4 picture tube is nearly 5 inches shorter than the standard 16AP4 16-inch type, is shown here. A sweep angle of 70 degrees for the 16GP4 against 53 degrees for the 16AP4 (portrayed in dotted lines) results in a flatter conical shell. This reduces the over-all length of the tube to 17 1/16 inches, compared with 22 5/8 inches for the 16AP4. Receivers using the new tube can be shorter and less bulky, consequently are more acceptable in the home.



You can put your confidence in—

GENERAL ELECTRIC

191-H2

Magnetic Materials

The Arnold Engineering Company offers to the trade a complete line of Magnetic Materials

PERMANENT MAGNET MATERIALS

- Cast Magnets, Alnico I, II, III, IV, V, VI, XII, X-900
- Sintered Magnets, Alnico II, IV, V, VI, X-900, Remalloy*
- Vicalloy* • Remalloy* (Comol)
- Cunico • Cunife • Cast Cobalt Magnet Steel

HIGH PERMEABILITY MATERIALS

- Deltamax Toroidal Cores • Supermalloy* Toroidal Cores
- Powdered Molybdenum Permalloy* Toroidal Cores • Permendur*

*Manufactured under licensing arrangements with WESTERN ELECTRIC COMPANY

Write for information relating to any of these Magnetic Materials

THE ARNOLD ENGINEERING COMPANY

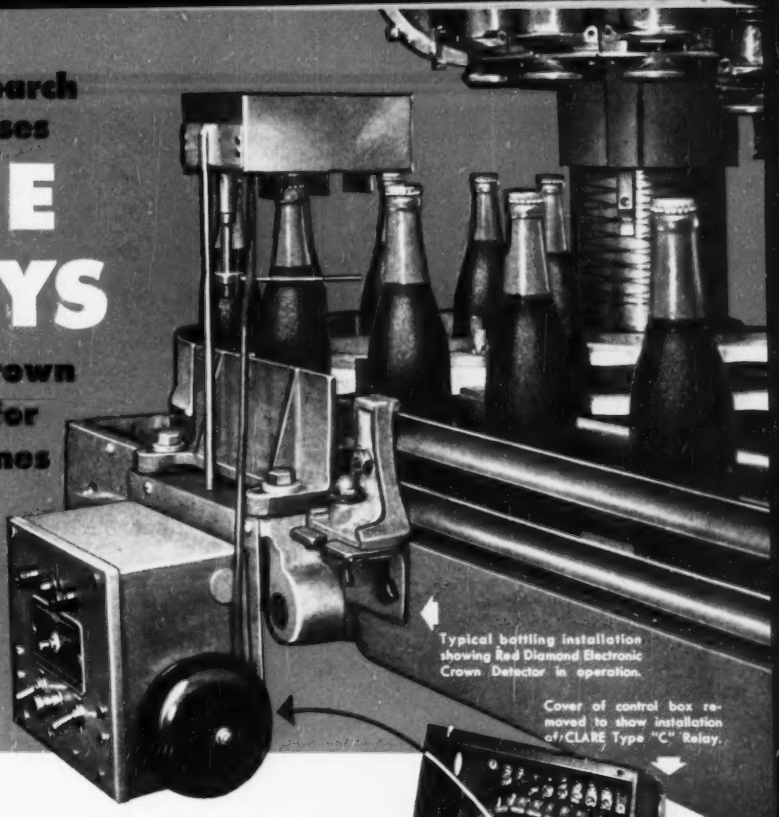
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

Industrial Research Laboratories uses

CLARE RELAYS

in Electronic Crown Detector Unit for Bottling Machines



Typical bottling installation showing Red Diamond Electronic Crown Detector in operation.

Cover of control box removed to show installation of CLARE Type "C" Relay.

Send for CLARE Engineering Data Book

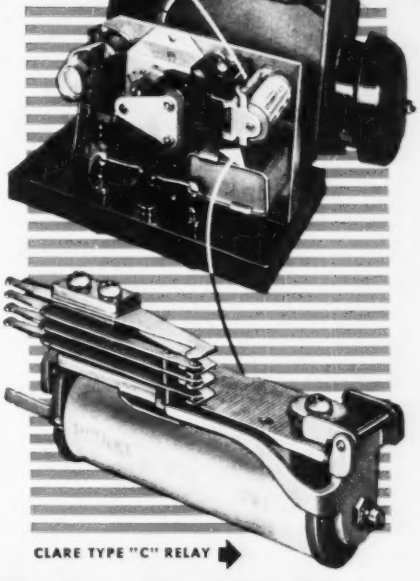
This book, sent on request, pictures and describes the complete CLARE line of relays and allied control apparatus to meet the widest variety of industrial uses.

This electronic device warns of any interruption of the crown supply in bottling operations. It is sold by Liquid Carbonic Corporation of Chicago and manufactured by Industrial Research Laboratories of Baltimore, Md.

A bottle feeler switch is inserted in the control grid circuit to close the circuit when a bottle passes between the poles. If a crownless bottle passes, an electronic tube momentarily operates the CLARE Type "C" Relay and an alarm sounds for a few seconds. Passage of the second crownless bottle causes the CLARE relay to stop the machine on the second operation.

CLARE relays were selected by Industrial Research Laboratories for this important operation because of their long reputation for accurate, long-life performance as components of devices designed for trouble-free operation, day in and day out. In larger plants, more than a million bottles per week pass through the machine.

If you have a difficult relay problem, a requirement where ordinary relays just won't do, why not take it up with our engineers? CLARE sales engineers are located in principal cities. They are experienced in the most difficult types of relay problems. We invite you to take advantage of their services. Call them direct . . . or write to C. P. Clare, 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.



CLARE TYPE "C" RELAY

CLARE RELAYS

First in the Industrial Field

Nearly a Quarter of a Century...

For 24 years the EDO *Flying Fish* symbol has been well known and highly respected in the aviation industry as the mark of ingenuity in design development and engineering as well as precision and efficiency in manufacturing.

This same EDO symbol is becoming an increasingly familiar label on highly advanced electronic devices for the United States Navy.

Among other things this equipment includes SONAR apparatus, developed and now being manufactured in the EDO plant, which makes possible new precision and accuracy in under-water detection.

EDO CORPORATION

COLLEGE POINT, L. I., NEW YORK

CONTRACTORS TO THE U.S. ARMY, NAVY AND AIR FORCE

HERE'S WHY THE C-D VIBRATOR IS THE BETTER VIBRATOR:
Designed by the finest vibrator engineering talent now working under the C-D banner. All the know-how and experience accumulated in the manufacture of vibrators for over 25 years concentrated in the new C-D vibrator line. Electronic micrometric equipment designed and produced at C-D has removed every bit of guess-work and factor of human error in C-D Vibrator manufacture. Samples to your specifications gladly furnished.
CORNELL-DUBILIER VIBRATORS
CD
VIBRATOR
TYPE
COO
ASE CIRCUIT
ONE OF THESE IS "HEADACHE-SEED"

-the other's a trouble-free Cornell-Dubilier Vibrator... *Yet both look alike!*

You can't tell the difference from the outside except for one thing—*the name*. If it says Cornell-Dubilier that's all you need to know, to know you've got the best Vibrator your money can buy!

For it's what goes *inside* that determines its capacity for performance. And inside every Vibrator bearing the C-D name is that invisible but invaluable ingredient engineers call know-how. The fact that leading radio engineers specify C-D Vibrators is significant recognition of their superiority. Inquiries promptly and intelligently handled.

Cornell-Dubilier Electric Corporation, Indianapolis, Ind., Dept. K119. Other plants in South Plainfield, N. J., Brookline and Worcester, Mass.; Providence, R. I., and subsidiary, The Radiart Corp., Cleveland, Ohio.

CORNELL-DUBILIER
CONSISTENTLY DEPENDABLE
★ CAPACITORS
★ VIBRATORS
★ ANTENNAS
★ CONVERTERS

A GREAT NAME IN CAPACITORS, A GREAT NAME IN VIBRATORS

Watch Master

Frequency Standards

GUARANTEED ACCURACY
1 part in 100,000 (.001%)

Type 212

TERMINATION
Front and Rear
CONSTRUCTION
Standard 8¾" x 19" Panel
HOUSING
8¾" x 19" x 8" Metal Cabinet
WEIGHT
25 pounds

Uses

Time bases, rate indicators, clock systems, chronographs, geo-physical prospecting, control devices and for running small synchronous motors.

Features

1. **Bimetallic, temperature-compensated fork, no heating or heat-up time is required.**
2. **Fork is hermetically sealed, no barometric effects on frequency.**
3. **Precision type, non-ageing, low coefficient resistors used where advantageous.**
4. **Non-linear negative feedback for constant amplitude control.**
5. **No multi-vibrators used.**
6. **Synchronous clock simplifies checking with time signal.**

Specifications

Accuracy—1 part in 100,000 (.001%).
Temperature coefficient—1 part in 1,000,000 per degree centigrade (or better).
Outputs—

1. **60 cycles, sine wave, 0-110 volts at 0 to 10 watts (adjustable).**
2. **120 cycle pulses, 30 volts negative.**
3. **240 cycle pulses, 30 volts positive and negative. Pulse duration, 100 micro-seconds.**

product of

AMERICAN TIME PRODUCTS INC.

580 Fifth Avenue New York 19, N. Y.

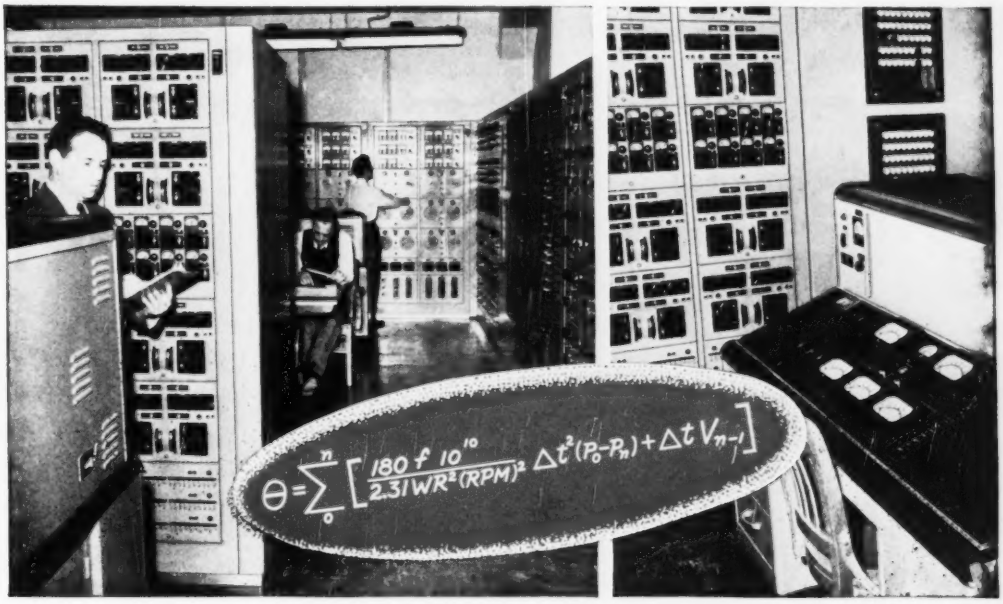
Operating under patents of the Western Electric Company

American Time Products, Inc.,
580 Fifth Ave., New York 19, N. Y.
Gentlemen:
Please send descriptive folder, No. 212

Name .....
Company .....
Address .....
City ..... State .....

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



WESTINGHOUSE INSTRUMENTS
Help Solve This Equation...in Minutes!

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What are your electrical measuring problems? The wide scope of the Westinghouse line, and the vast experience that backs it up, provides the electrical measuring instruments to fill *your* needs exactly . . . no matter what the problem. That's why Westinghouse instruments have long been the choice of design engineers in every field of industry.

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Custom Craftsmen in Sheet Metal

NEW G-E *Triple-Play* CARTRIDGE PLAYS ALL 3 SPEEDS

Latest Dual Stylus Unit Tracks 33-1/3, 45, and 78 rpm Records at Constant Pressure

Costs 25% less than Pickups it Replaces

A new General Electric "Triple Play" Cartridge that tracks any commercial record is now available to manufacturers, distributors, and dealers.

Simplicity is the key feature of this notable electronic advancement. Once installed in a tone arm, the cartridge will play all types of popular narrow groove and standard groove records *without replacement or even a change in position!*

ONLY ONE PRESSURE

The new cartridge retains the unsurpassed frequency response characteristics of the famous G-E Variable Reluctance unit and in addition, tracks the three types of records at 6 to 8 grams. Thus the pressure is constant regardless of the stylus you're using. The special design of the "Triple Play" permits precise adjustment of tone arm pressure. Weight changing and pressure compromise problems are eliminated. High compliance and low moving mass reduce record wear to a minimum.

TWO STYLI IN ONE CARTRIDGE

A single twist of a built-in knob turns either end of a dual stylus to playing position. A 1-mil stylus, mounted at one end, plays 33⅓ and 45 rpm records, and a 3-mil stylus, at the opposite end, tracks standard 78 rpm records.

MANUFACTURERS NOTE LOW COST

Although it plays records that formerly required the use of two cartridges, the price of the "Triple Play" is 25% *less* than the price of two individual cartridges. It is adaptable to many types of tone arms and *its use as an initial component will effectively reduce set manufacturing costs.*

UNAFFECTED BY TEMPERATURE

The G-E "Triple Play" is unaffected by normal climatic changes in humidity and extreme variations in temperature. Needle talk and needle scratch are reduced to a minimum. Record reproduction—as always with G-E Cartridges—is superb. Mail coupon below for complete information.

You can put your confidence in
GENERAL ELECTRIC

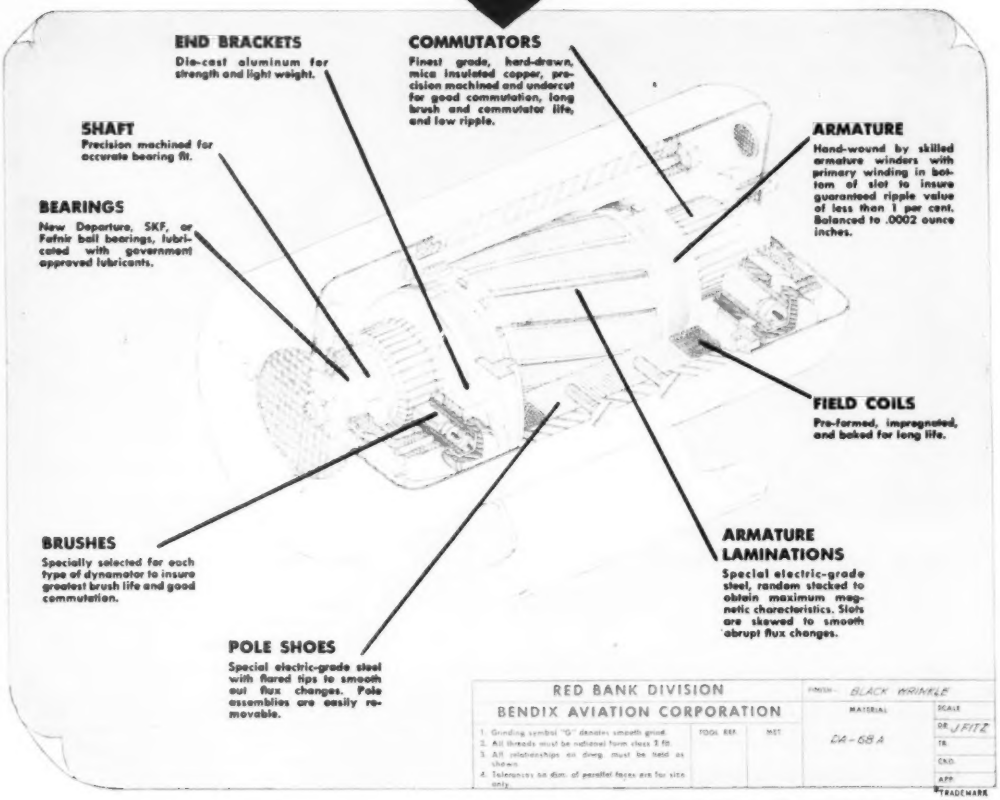
General Electric Company, Parts Section 1E
Electronics Park, Syracuse, New York
Send me full particulars on the new G-E "Triple Play" Cartridge.

NAME_____

ADDRESS_____

CITY_____ STATE_____

What makes BENDIX* dynamotors SO MUCH BETTER? For the answers look inside!


END BRACKETS
Die-cast aluminum for strength and light weight.
COMMUTATORS
Finest grade, hard-drawn, mica insulated copper, precision machined and undercut for good commutation, long brush and commutator life, and low ripple.
SHAFT
Precision machined for accurate bearing fit.
ARMATURE
Hand-wound by skilled armature winders with primary winding in bottom of slot to insure guaranteed ripple value of less than 1 per cent. Balanced to .0002 ounce inches.
BEARINGS
New Departure, SKF, or Fafnir ball bearings, lubricated with government approved lubricants.
FIELD COILS
Pre-formed, impregnated, and baked for long life.
BRUSHES
Specially selected for each type of dynamotor to insure greatest brush life and good commutation.
ARMATURE LAMINATIONS
Special electric-grade steel, random stacked to obtain maximum magnetic characteristics. Slots are skewed to smooth abrupt flux changes.
POLE SHOES
Special electric-grade steel with flared tips to smooth out flux changes. Pole assemblies are easily removable.
RED BANK DIVISION
BENDIX AVIATION CORPORATION
FINISH — BLACK WRINKLE
MATERIAL
DA-68A
SCALE
DR. J.FITZ
TR.
CKD.
APP.
1. Grinding symbol "G" denotes smooth grind.
2. All threads must be national form class 3 fit.
3. All relationships on dwg. must be held as shown.
4. Tolerances on dim. of parallel faces are for size only.
TOOL REF.
MAT'
*TRADEMARK

It Pays to buy Quality . . . and no finer Quality Dynamotor is available than a BENDIX DYNAMOTOR

Dynamotors • Inverters • Converters • D.C. Motors • Carbon Pile Voltage Regulators

RED BANK DIVISION of Bendix AVIATION CORPORATION
RED BANK, N. J.

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, New York

TEMPERATURE RISE—40° C.

STARTING TIME—.3 seconds (or less if specified).

VIBRATION RESISTANCE—Will withstand .03 inches (.06 total excursion) between 10 and 60 c.p.s., without special mounts.

TEMPERATURE RANGE—Will operate through ambient range of —55°C to +85°C.

ALTITUDE—Will operate normally to 20,000 feet and higher if special altitude brushes are specified.

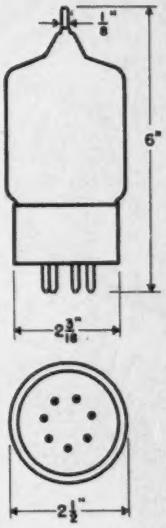
CAA APPROVAL—All Bendix dynamotors are capable of meeting Civil Aeronautics Authority type Certification tests and are in use by major, scheduled airlines and government services.

INSPECTION AND TEST—All Bendix Dynamotors are carefully inspected in every step of production. Every unit receives a six to twelve hour run-in, depending on type, to insure proper brush seating.

A NEW, VASTLY IMPROVED 4E27

EIMAC PENTODE TYPE 4E27A/5-75A

- MORE RUGGED PLATE-LEAD
- PYROVAC PLATE
- OVERSIZE PLATE
- NON-EMITTING GRIDS
- MECHANICALLY RUGGED
- MOULDED-GLASS HEADER
- LOW-LOSS LEADS
- EASILY COOLED STEM



Encompassed in the structure of this new version of the 4E27 are many outstanding improvements that now will guarantee performance-dependability to users of this tube type.

The plate-lead of this new Eimac 4E27A/5-75A pentode is of larger diameter than the protype* providing a low-loss, low inductance, more rugged lead. The plate itself is larger assuring a good reserve dissipation capacity above its 75 watt rating. It is made of Eimac Pyrovac plate material, which lengthens the life of the tube and enables it to withstand high momentary overloads.

Primary grid emission has been eliminated and secondary characteristics stabilized through the use of Eimac processed grids. Perfected beam-action and permanent alignment are assured through well engineered internal-element mounts.

The unique moulded-glass header eliminates a base on the 4E27A/5-75A. This simplifies lead cooling, minimizes lead losses, and provides precision alignment of base-pins.

The stability and high power-gain characteristics of this new Eimac pentode make it an excellent VHF or video power amplifier. It is equally well suited for conventional power amplifier service.

Further information and detailed characteristics concerning this latest product of Eimac engineering research may be had by writing the Application Engineering Department of Eitel-McCullough, Inc.

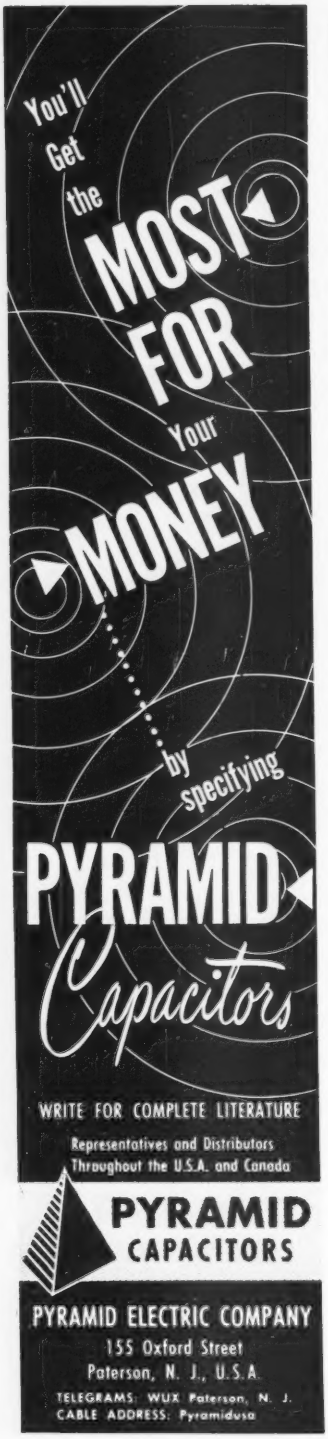
* Lead connector is supplied to make this new tube directly interchangeable with 4E27.

236

EITEL-McCULLOUGH, INC.
San Bruno, California

EXPORT AGENTS: FRAZAR & HANSEN, 301 CLAY ST., SAN FRANCISCO, CALIFORNIA

Follow the Leaders to Eimac TUBES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BUSINESS BRIEFS

By W. W. MacDONALD

Quick Swing among a widely diversified group of companies as far west as Illinois just before deadline resulted in the following impressions:

(1) Most manufacturers are convinced the fall upswing in business will carry through into 1950; few think it is just a flash in the pan.

(2) Poor sales during the summer are generally considered the result of a "business man's panic" rather than lack of consumer interest and purchasing power; trade pipelines are still not filled to normal capacity on many items.

(3) Efforts to reduce costs by improving manufacturing techniques and acquiring more efficient machines are nearing the practical limit at the moment; economies in the immediate future are more apt to come from reduced raw material and component part costs.

(4) Expenditures for new manufacturing plants and equipment are not apt to exceed those of the past year in our field and will probably fall below that level; many expansions were accomplished during the war and substantial changes are unlikely to be needed as early as 1950.

(5) Current emphasis is being placed on improvement in sales techniques rather than design and production; most managements seem to feel that they have not yet fully adapted themselves to the change from seller's to buyer's market.

(6) Devaluation of the pound may have a detrimental effect upon American exports but most manufacturers think this will be of short duration and are not particularly concerned; exports are generally poor anyway and will probably remain so until world conditions settle down.

We Like the following phrase, picked up from a Cincinnati manufacturer, in view of the current emphasis upon selling: "You can control yourself into bankruptcy . . . or sell yourself out of trouble."

B36 Investigation reporters quoted Lieutenant General Curtis E. LeMay of the Strategic Air Command as saying that the airplane flies so high it is proof against detection by ground radar. This is very high indeed, so we checked with the General.

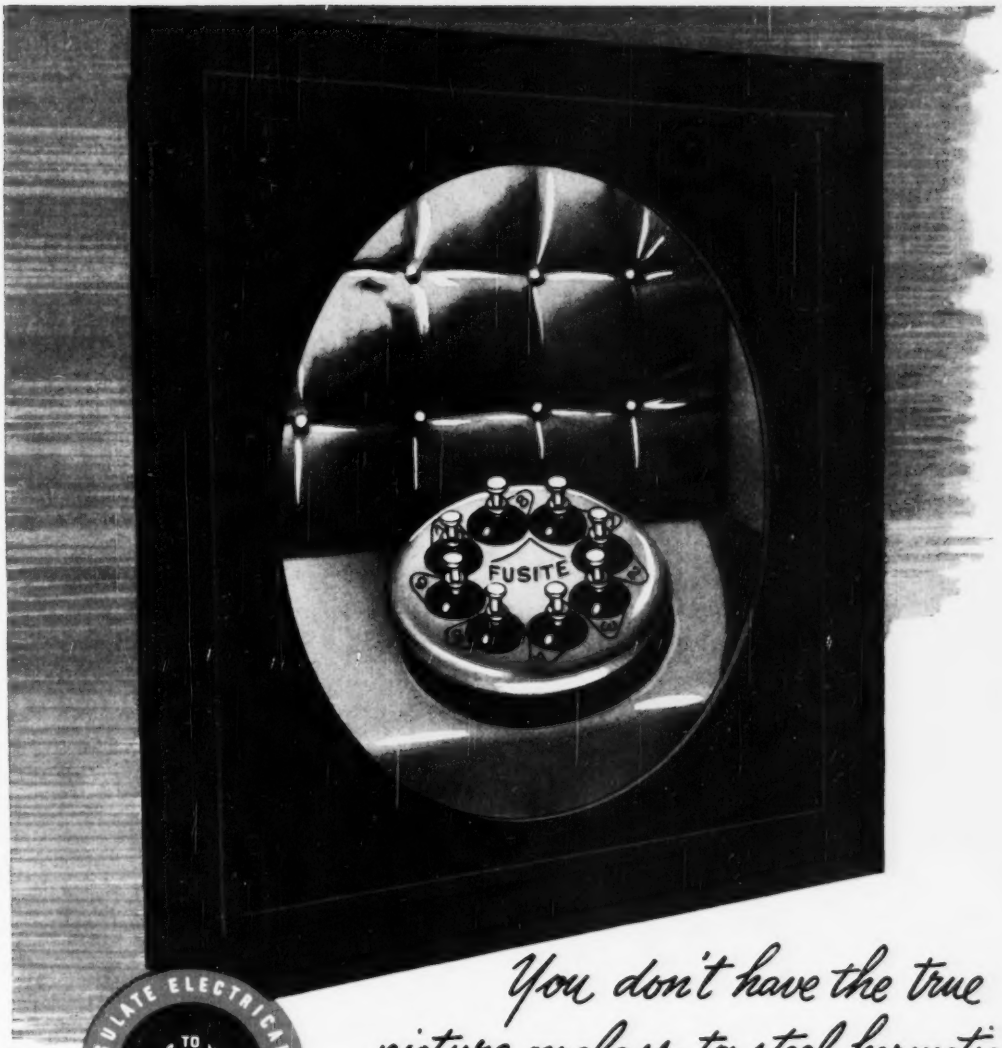
He says he did not intend to infer that existing radar under ideal circumstances could not pick up a B36 at extreme altitude. He meant that detection would be difficult and unreliable when the planes operated at high altitude over rain, sleet or snow, and when they used mechanical anti-radar measures. Confusion engendered by large-scale attack, plus the large terrain to be guarded, would further complicate detection.

As Predicted (p 60, July) Parts Show policy makers received many complaints because attendance at their last shindig in Chicago was at times restricted to NEDA members. So the 1950 show will be open to all distributors, without restriction.

U. S. Government Purchases of radio transmitting and communications equipment from RMA members totalled $32,018,903 in the first quarter of 1949 as against $18,053,969 in the first quarter of 1948 and $37,018,903 in the last quarter of 1948.

New York City, so far as we know, has the largest police radio system in the world. Equipment in use and on order includes seven 250-watt base transmitters and seven auxiliaries, 650 cars with two-way gear and 300 with receivers only, 12 transmitter-equipped launches, four airplanes, six service trucks and a headquarters car.

If All The Stories manufacturers put out about how their equipment worked after being dredged up from the bottom of a lake with a grappling iron, or re-



INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

You don't have the true picture on glass-to-steel hermetic terminals unless you've tried Fusite!

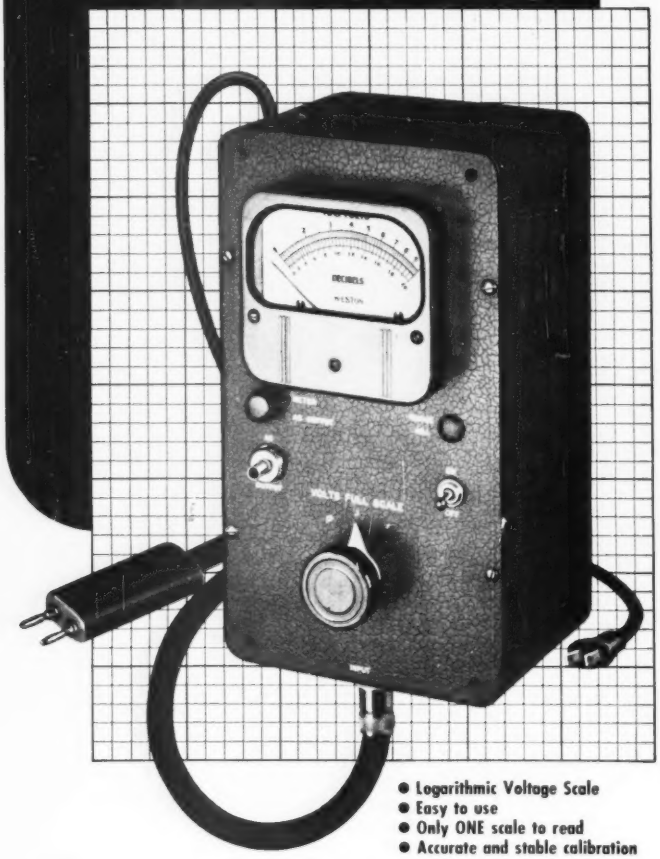
TERMINAL ILLUSTRATED: 908TH
Typical of turret head series. Available in 2 to 9 electrodes.
Numbering identification standard feature.

THE FUSITE CORPORATION

CARTHAGE AT HANNAFORD, NORWOOD, CINCINNATI 12, OHIO

R.F. VOLTMETER

For Measurement of Very Low AC Voltages



- Logarithmic Voltage Scale
- Easy to use
- Only ONE scale to read
- Accurate and stable calibration

MODEL 304 R.F. VOLTMETER. This instrument measures AC voltages over a range of 1 millivolt to 100 volts from 30 cycles to 5.5 megacycles. Probe type input connector attached by a flexible cable provides true indication of voltages at point of origin in circuits. Accuracy of voltmeter readings are within 5%. Input impedance is 1 megohm shunted by 9 mmfds. Can be used as wide-band amplifier. Especially useful for reading millivolts in television and FM intermediate frequency amplifier circuits, RF heating apparatus, carrier current systems and in particular for extending useful frequency range of ordinary oscilloscopes to beyond 5 megacycles.

PRICE....$225.00

In addition to the Model 304 R.F. Voltmeter, Ballantine Laboratories also manufacture AC and Battery Operated Audio Frequency Electronic Voltmeters, Peak to Peak Voltmeters, Geiger-Muller Counter Tubes, and the following accessories—Decade Amplifiers, Multipliers, Precision Shunt Resistors, etc.

BALLANTINE LABORATORIES, INC.
BOONTON N. J. · U.S.A.

moved with asbestos gloves from a fire, were laid end to end it would be a good thing.

TV Receiver Production by RMA members totalled 913,071 during the first half of 1949. Shipments trailed a little, totalling 742,166, broken down by areas including communities within 50 miles of stations as follows:

Albany	9,801
Albuquerque	71
Atlanta	2,184
Baltimore	21,158
Birmingham	2,199
Boston	49,286
Buffalo	12,092
Charlotte	1,718
Chicago	77,278
Cincinnati	19,196
Cleveland	31,406
Dallas	2,016
Davenport	472
Detroit	36,535
Erie	690
Greensboro	562
Houston	2,106
Huntington	30
Indianapolis	5,704
Jacksonville	95
Kansas City	4,549
Los Angeles	60,407
Louisville	2,042
Memphis	1,970
Miami	2,800
Milwaukee	10,439
Minneapolis	4,711
Nashville	58
Newark	59,978
New Haven	10,733
New Orleans	1,691
New York City	152,619
Oklahoma City	2,810
Omaha	1,103
Philadelphia	75,222
Phoenix	22
Pittsburgh	15,185
Portland	425
Richmond	2,879
St. Louis	12,944
St. Petersburg	51
Salt Lake City	861
San Antonio	87
San Francisco	7,897
Seattle	2,591
Syracuse	2,196
Toledo	7,378
Tulsa	203
Washington	22,709
TOTAL	742,166

Many Letters we receive asking questions about the citizens radio band indicate that ultimate use would be at least semi-commercial. This, the FCC tells us, is not permissible. Citizens radio, like amateur radio, must be strictly "no pay."

Another Tip we pass along concerning citizens radio is that converted BC-645's so far tested by the FCC have failed to meet technical requirements for approval.

Tom Conrad of Venice, California says that people accustomed to concentrating in noisy areas should be able to recite through to the end of simple jingles (p 60,

September) even though their first words are simultaneously played back to them via a recorder.

No Answers were received in response to our invitation (p 60, September) to solve the Army-Navy-Airforce component-part problem. Many manufacturers can build them, it seems, but nobody can afford to stock them. One reader commented, simply, "the government is a very fickle customer."

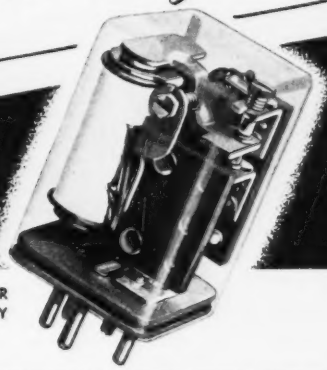
This Month our feature pages include an article about an inductive prompting system used by Hollywood movie directors. We wonder if the scheme could be used in a television studio without interfering with picture circuits. An article about an electronic reciprocator also in this issue really should contain an offer of a prize for suggested uses of the trick circuit and, despite the fact that we are supposed to be a staid engineering magazine, we almost offered one. The story about tv reception below line of sight should interest many readers riding tv as a hobby, even if it does not suggest commercial antenna and front-end designs. And we are inclined to brag about our yarn on magnetic fluid clutches because it suggests, so far as we know, the first practical use for the relatively new devices within the field of electronics.

Coming Issues will contain more than the usual number of articles about new tubes, as the industry seems to be breaking out in a rash of tube designs for many new and some old applications. Things are moving fast in the field of television, so watch also for a heavier diet of articles on tele transmitter and receiver design in our columns in the near future.

Back in 1930 McGraw-Hill coined the word Electr*onics*. The suffix rolled nicely off the tongue and recently inspired the naming of another company magazine Nucleo*nics*. Now one of our confreres is toying with the word avio*nics* and we wonder where this is going to end.

That final suffix should, perhaps, be spelled *nix*.

What Price Sensitivity?



SIGMA TYPE 5R
SENSITIVE RELAY

The immediate consequence of demanding increased sensitivity in a relay is an *increase* in size, weight, and (usually) cost. The explanation is not hard to find.

Starting with the contacts, a requirement is established for a certain force and stroke depending on desired switch capacity. This ultimately leads to a requirement for a certain number of ampere turns to operate the switch. If coil resistance is to remain fixed, increased sensitivity will be evident in a reduction of operating current requirements. Hence if we need a given number of ampere turns at a lower value of current, we must have more turns. But if the resistance may not be increased, we must use *larger* wire, and thus a *bigger* magnet. Similar consequences arise when designing the iron parts of the relay — increased real or power sensitivity demands increased size.

It is possible to minimize this adverse relationship. In the relay pictured above the two-pole magnetic structure has no wasted air gaps. Polar enlargements and iron of exceptional permeability help to reduce the ampere turn requirements. Core diameter held to the minimum necessary for requisite flux gives a short mean turn length, and a large number of turns per ohm. Micrometer adjustment permits working at exactly favorable stroke positions.

The resulting relay, moderate in size and cost, will, when wound with #44 wire, operate on as little as .00025 Ampere, and withstand 10g vibration adjusted at .00060 Ampere. (16000 ohm coil, one and five milliwatt adjustments).

SIGMA

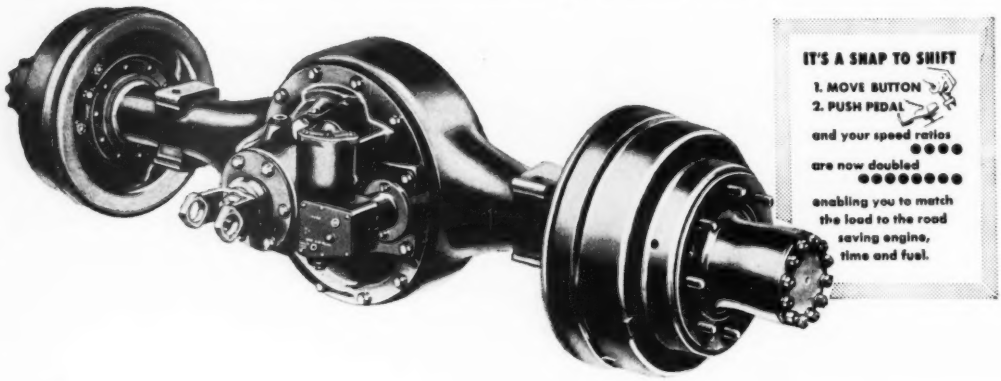
Write for informative catalog describing other types and listing typical adjustments.

Sigma Instruments, INC.
Sensitive **RELAYS**
62 CEYLON ST., BOSTON 21, MASS.

MALLORY

Takes Nothing For Granted...

and the Eaton Manufacturing Company is Pleased!

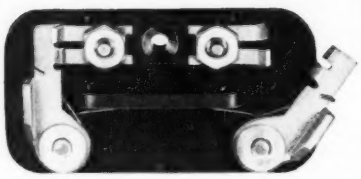


The popular Eaton 2-speed truck axle is controlled by a little button. The driver moves it and the truck's speed ratios are doubled in number. Crushing loads start with ease. Rough uphill hauls in quarries or in construction jobs are a cinch. And owners save wear, tear and money on their truck equipment!

When planning the electric shift, the Eaton Company submitted specifications for the required switch to Mallory.

Mallory engineers looked at the design submitted to them with inquisitive eyes. Backed by the greatest pool of experience and skill in the field, Mallory engineers suggested manufacturing methods that resulted in appreciable production cost savings at no sacrifice in performance.

If you are in the throes of a design problem calling for precision electronic parts—switches, controls or resistors—it will pay you to call in Mallory engineers now. Their record in the industry is famous. Because they take nothing for granted, you'll be sure of getting the finest design at the best possible price.



Clean-cut, simple, long wearing and trouble-free, this Mallory-made switch used to activate the Eaton 2-speed axle is typical of the kind of product that has made Mallory "switch headquarters" for American industry.

Precision Electronic Parts—Switches, Controls, Resistors

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors	Rectifiers
Contacts	Switches
Controls	Vibrators

Power Supplies

Resistance Welding Materials

CROSS TALK

►**COLOR** . . . The system of color television recently announced by RCA (see Electron Art, this issue, for details) is designed to accomplish what would have been considered wholly impossible five years ago: the addition of color values to a black-and-white image without enlargement of the bandwidth occupied by the black-and-white signal and without degrading the pictorial detail of the image. When the announcement was first made there were, we are sure, moments of disbelief in many an engineer's mind. But as the details of the system have been released, the theoreticians have agreed that the techniques employed do in fact permit the objective to be reached, and the practical men are facing with confidence the problem of improving the terminal equipment. The relative merits of this system and the several other proposals made before the FCC at the color tv hearing are still being debated, and it is certainly not our place here to attempt to resolve the issues. But we do think a few general comments can, and should, be made.

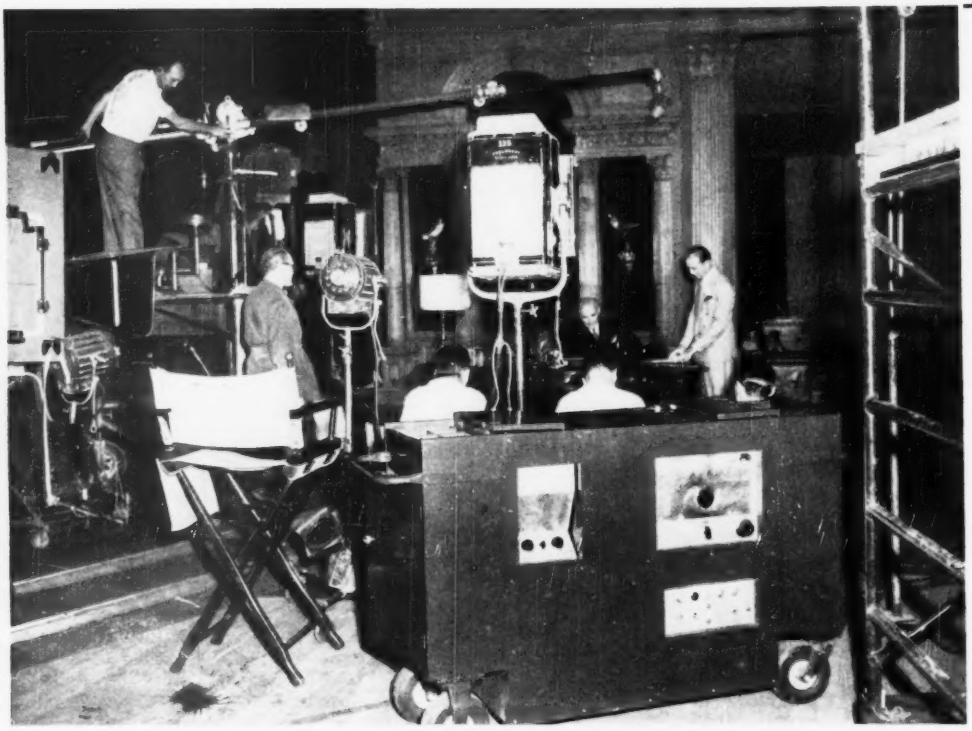
The essence of the new system is the combination of three unrelated developments in television and communications technology. First a double system of interlacing is used. Ordinary horizontal "line" interlace has been used for nearly 20 years because it permits halving the flicker-free frame rate, thus doubling the detail of the image for a given bandwidth. The vertical "dot" interlace of the new color system gives an additional factor of two. This has always been a good idea, even for black-and-white images, but only in recent months have the problems of generating and reproducing dot interlace been solved. Second, a time multiplex system of sampling the tricolor signals is used, the samplers at transmitter and receiver being kept in step by the conventional sync pulses. This idea, which makes much more efficient use of the bandwidth than the conventional system of signalling, didn't originate in the tv art at all. The multiplex system, using a much slower sampling rate, was developed for point-to-point communications. Third, the mixed-highs method of transmission, which restricts the detail of the color images and restores the missing detail in tones of gray, is used.

In short, to shoe-horn 525-line color images into a 6-mc channel has required the use of every trick in the bag. But they are, or at this writing seem to be, good tricks and practical ones. This is not to say that all compromises have been avoided. But a most ingenious assembly of latter-day techniques has been brought together, one which warms the convolutions of the technical mind.

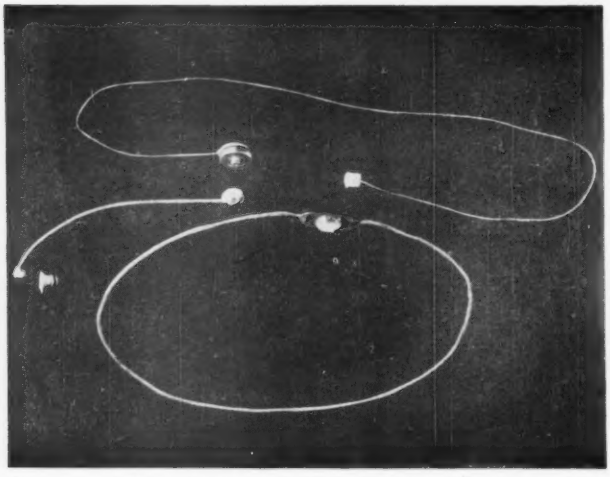
►**ENCLOSED** . . . In September, in this column, we rambled about semiconductors and their place in the electronic scheme of things. We endorsed the suggestion that the term "electronic device" should include semiconductor devices and that a germanium diode or triode enclosed in a gas-tight envelope be called an "electron tube". At that time we didn't know that certain germanium diodes were in fact so enclosed. Norman Krim hastened to write that the type CK705 germanium diode is one example, the purpose of the enclosure being to exclude water vapor and to prevent the possibility of chemical attack on the germanium. So this unit, and perhaps there are others, qualifies as an electron tube. We think this is as it should be, but we suspect many readers may object to calling a crystal rectifier a tube no matter how it may be enclosed. Now that we have a concrete example before us, do we hear objections?

►**INCIDENTAL** . . . We are most happy to note that "incidental radiation", the emission of signals or interference from various industrial and commercial devices not used for communication with a receiver, has been recognized, by the FCC and the industry, as a nuisance requiring a coordinated attack. The FCC Conference on this subject, scheduled for November 1 (see p 130, this issue) may not have the glamorous urgency of the tv hearing or the vhf-uhf propagation meetings, but it is urgent nonetheless. We hope all those in a position to contribute to the abatement of this evil will attend.

Inductive PROMPTING

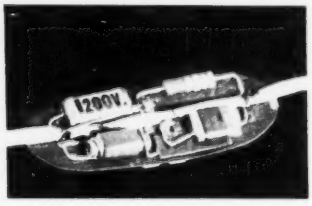


Magnetic-field transmitter (in foreground) being used to cue actors in an actual movie production



A complete receiving unit, including receiver and pickup loop, earphone and cord, and plastic tube and ear plug

Make-up is used to hide the exposed parts of the plastic sound tube and ear plug



Actual-size view of receiver with protective cover removed

SYSTEM

. Lund

The hearing-aid type earphone is fastened out of sight on the actor's clothing and the sound carried to the actor's ear by means of a photographically invisible plastic tube and a special ear plug

Communications system allows director to cue actors in motion picture scenes without interference to regular sound system. A modulated magnetic field is picked up and demodulated in concealed receivers and conveyed to actors through photographically invisible earphones

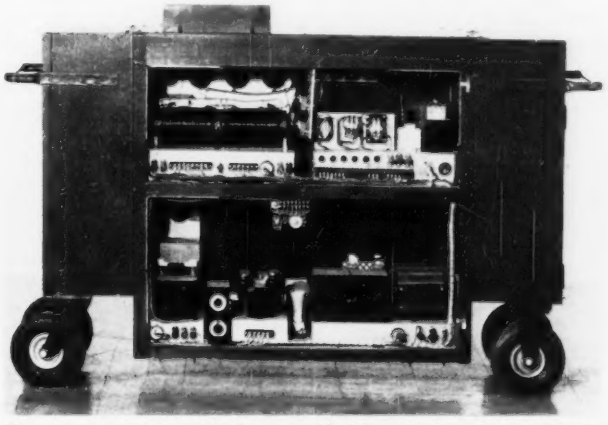
By BRUCE H. DENNEY and ROBERT J. CARR

Paramount Pictures, Inc.
Hollywood, California

TWENTY YEARS have passed since the addition of sound to movies eliminated the director's megaphone for prompting actors during the photographing of scenes. In general, producers have relied on extra rehearsal time to take its place. Various tricks have been tried, such as offstage gestures and light signals, but these methods have not been very satisfactory.

There has been a growing demand for a simple radio-type receiver that can be worn inconspicuously on the actor's person. For maximum utility, the ear piece has to be photographically invisible, and the receiver has to be capable of picking up the director's instructions from various positions on the movie set.

Equipment is normally used within sound stages which are unusually well shielded with building-wire screen supporting exterior stucco walls. Inside the stages acoustical control materials are often supported by more wire screen. Pipes, conduits, and ducts form a complex shielding pattern.



The entire transmitter is contained in a portable dolly so that it can be moved rapidly from one set to another

Frequency Choice

The radio approach seemed logical. However, at frequencies of 30 megacycles or higher a transmitter's radiation beyond the stage walls would be negligible, but inside the stage the standing-wave patterns would make the use of an efficient automatic volume control or limiter necessary. The efficiency of an antenna worn near the body would be low and variable. Several tubes would be required, so if an estimated fifty receivers were to be built there would be a definite maintenance problem.

With a lower frequency larger coils and capacitors would be required and, although the standing-wave problem might be less, considerable amplification would be required to overcome the loss caused by the limited antenna size. Radiation beyond the stage walls would probably be troublesome.

Experiments with simple radio receivers at frequencies from 1,500 kilocycles to 460 megacycles confirmed the need of amplification and automatic volume control. However,

even if subminiature tubes, printed circuits, and the smallest batteries available were used, a receiver could not be packaged small enough to be concealed in many of the costumes worn by actors and actresses. The smallest hearing-aid earphone was not invisible photographically, and all receiving antennas were difficult to conceal.

It was decided to limit the area of good reception to about 40 by 60 feet. This suggested an inductive rather than a space-radio system. The receivers could be simple, tubeless, batteryless and expendable in case of trouble. Crystal detectors could be used if the transmitter were powerful enough. In this manner the maintenance problem would be limited to one transmitter and its input equipment.

The system finally adopted incorporates a 100-kc transmitter connected to a single-turn loop which surrounds the set area and induces a strong r-f field at all points within the area. Each actor wears a multiturn loop of wire in which a secondary current flows. This current is of sufficient magnitude that when demodulated it is capable of delivering a good output from a hearing-aid type earphone.

The Receiver

The receiver, whose circuit is shown in Fig. 1, uses miniature components mounted on a small terminal card to which the loop is secured and connected. The loop is covered with rubber tubing and the equipment card is covered with an air-drying rubber compound.

The loop-receiver is normally worn around the neck in a plane parallel to the floor, and the small crystal earphone unit is taped or pinned under the clothing. Coupled to the earphone unit, 0.090-inch diameter plastic tubing is brought out of the collar over and down the front of the ear and into the ear as shown in accompanying photographs. The tubing is terminated in a small plastic L which is adapted to the ear canal by means of various-size rubber inserts. The small-diameter tubing blends into the convolutions of the ear and requires careful make-up only across the more exposed neck area.

Strapless evening gowns offered a problem until smaller 6-inch diameter loop receivers were built and concealed in the actress' hair. The output from the smaller-loop receiver is several decibels below the larger 10-inch diameter units but has been satisfactory.

The Transmitter

The r-f section of the 100-kilocycle transmitter, shown in Fig. 2, is push-pull from the crystal oscillator to the class-C output stage. The plate circuit of the output stage is tuned by a variable inductance and a group of fixed capacitors. A variable capacitor for this frequency and for the voltage used would be of an awkward size, therefore the capacitor values are selected by a coarse-tuning tap switch. Fine tuning is accomplished by a variometer-type rotor in the electrical center of the inductance. The impedance of the single turn of wire surrounding each different set area changes the effective inductance of the output coil, making it necessary to retune for different loops. This is the transmitter's only critical adjustment.

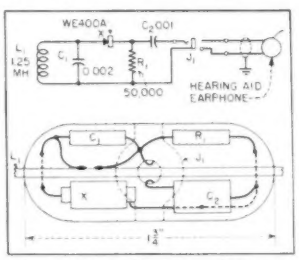


FIG. 1—Circuit diagram and drawing showing placement of receiver parts

Audio Equipment

The audio amplifier, Fig. 3, has both a microphone input and a low-gain playback bridging input. Each has its separate gain control. A tapped control in five 10-decibel steps on the playback input-transformer secondary adjusts for different level playback sources and prevents overloading of the playback input stage. A relay operated from the push-to-talk button on the microphone automatically reduces the playback volume 10 decibels, if desired, when the microphone is used.

Equalization in the plate circuit of the microphone stage improves the intelligibility from the microphone. The microphone is usually held very close to the director's lips as he speaks in low volume, or a whisper. Equalization in the plate

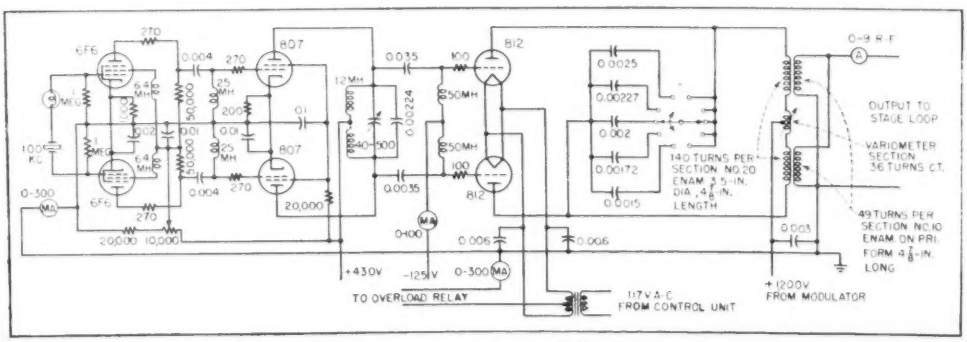


FIG. 2—Circuit diagram of the r-f portion of the 100-kc induction-type transmitter

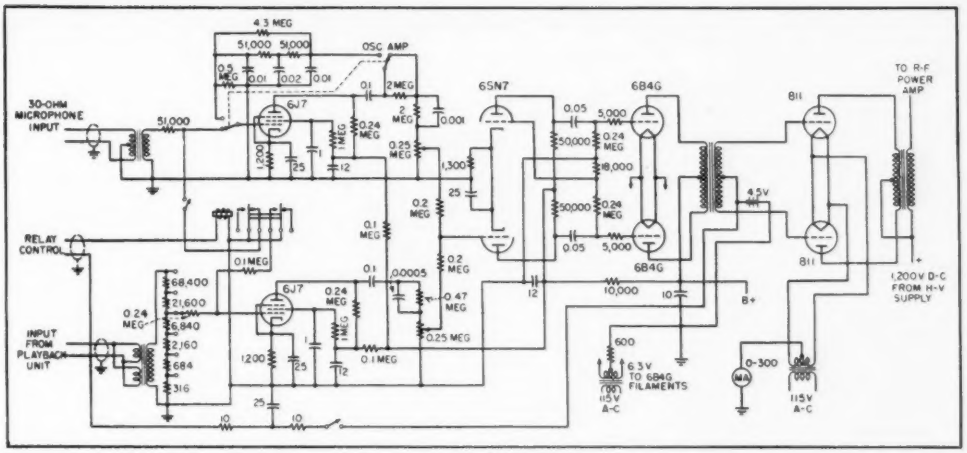


FIG. 3—Speech amplifier and modulator circuit diagram. Equalization is adjusted for loudness rather than for quality

circuit of the playback stage has been selected for loudness instead of quality. Attenuating music's low-frequency components by 10 decibels permits a much louder signal to be transmitted without overload.

A switch changes the microphone amplifier stage into a 400-cycle R-C oscillator used for checking the equipment and field strength. The field is uniform enough that receiver volume controls are unnecessary; the audio level is adjusted in the speech amplifier with the class-B modulator plate-current meter serving as a volume indicator.

Storage facilities for the loop-receivers, earphones and attachments and cables and spare parts have been built into the transmitter dolly which is shown in an accompanying photograph.

Transmitting Loops

The single-turn transmitting loops are placed around the set to be energized at any convenient level from below the floor to 12 feet above the floor. Due to photographic angles and set construction some loops have been used under the floor level for part of the loop and above the floor for the remainder of the loop. Number 10 or 8 wire is used to reduce the resistance and increase the loop current, the value of which will usually be between 2 and 9 amperes.

Circular, square and rectangular loop patterns have been used. The success of the transmitter in covering areas up to 40 by 60 feet with ample volume naturally brought demands for an increased area of coverage. In one long dolly or moving camera scene in an L-shaped area it was difficult to get a strong signal if the loop was run across the diagonal corners of the L. The loop was installed on the margins of the L in the form of block L whose thickness was 20 feet and whose width and length were about 70 and 120 feet.

In a recent picture, one scene required a dolly shot 250 feet long. The camera preceded the actor for nearly 250 feet as he sang a song accompanied by a piano playing outside the stage. The pianist, wearing phones bridged across the sound recording system heard the singer; the singer heard the piano music through his concealed receiver, but the sound recording microphone heard only the singer's voice. The orchestra was added later. For this scene two rectangular loops, each 20 feet wide by 125 feet long, were used. They were placed end to end, with a few feet of overlap, properly phased, and connected in parallel. The wire was buried an inch below a dirt surface. An excellent signal resulted.

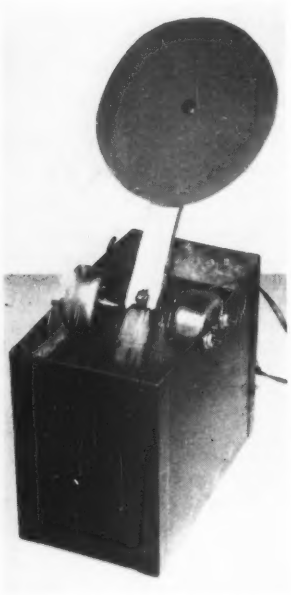
During the experimental stages of the magnetic-field transmitter design, tests were made whereby the audio signal was applied directly to a transmitting loop while the receivers were used without the demodulating crystal diodes. Such a system worked and certainly was less complex and less expensive than the 100-kilocycle carrier system. However, no method was found to prevent interference with the sound recording system where the unwanted signal was picked up not only in the sound-recording microphone circuit, but also in all low-level audio equipment in the vicinity of the loop.

With the 100-kilocycle system little interference is encountered, although the sound-recording microphone and its preamplifier are within the field, because the recording system's response rapidly decreases at frequencies above 15 kilocycles, and the 100-kilocycle signal will only be demodulated in the recording system if an audio stage is nonlinear, or overloaded. If a more than ordinary amount of low-level equipment is used within the field, or there is cable shield trouble, some interference may be heard but it is readily removed by small plug-in filters.

The writers wish to acknowledge the assistance and valuable suggestions of Loren L. Ryder, Director of Recording of Paramount Pictures, Inc.

The RECIPROCATOR

A ring oscillator comprising two one-shot multivibrators in which the on and off periods can be controlled from 0.2 to 1.5 seconds energizes linear or rotary solenoids to generate complex reciprocating motion. System is useful in low-power pumps for corrosive liquids and in handling radioactive materials



Stirring device for liquids using a pair of rotary solenoids driven by the electronic reciprocator

A NUMBER of interesting uses has been suggested for an electronic device to produce reciprocating motion in which the time of the forward and back movements can be varied independently and the distance-time relationship during the stroke controlled.

Such a device would permit the operation of a plunger of magnetic material inside a tube having a nonmagnetic wall. In this manner, a corrosive liquid might be circulated without the use of a packing or stuffing box element. It could also be employed for a shaking or vibratory device in which unusual control features are necessary. Instrumentation in the field of nucleonics poses many new problems for control and handling of highly radioactive materials at a distance, for which such a device can be used.

Experimental Application

A crude working model of a liquid-stirring machine is illustrated. The reciprocating paddle is driven by a pair of rotary solenoids. This type of solenoid produces an angular motion with a much more constant torque throughout its stroke than is obtainable by ordinary types.

This fundamentally electromagnetic device is driven by impulses from a low-power electronic device known as a reciprocator. Electrically, the equipment involves three basic units:

(1) An electron-tube circuit to form the desired characteristic of current impulse. This may be expressed as a curve showing the relationship between current to the solenoid and time for each stroke.

(2) A power amplifier by means of which the current impulses with the desired characteristic of time and current may be amplified to the necessary power level.

(3) Some form of magnet or solenoid for transforming the current from these units into a reciprocating motion.

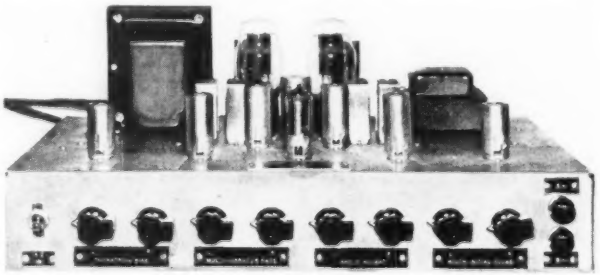
The current fed into the solenoid or electromagnetic winding is a rectified 60-cycle current. In most cases, however, the inductance of the winding smooths out the current sufficiently to minimize undesirable cyclic torque variations during the operating strokes.

Circuit Details

In the circuit of a practical equipment shown in Fig. 1 (waveforms in Fig. 2) the following features are provided:

(1) Duration of the impulses is given as MULTIVIBRATOR RATE on the nameplate under two controls shown in the illustration. This circuit consists of two one-shot multivibrators connected as a ring oscillator. By this means, the time during which each pulse (forward and backward) lasts may be controlled independently. The values chosen for this unit can be adjusted between 0.2 and 1.5 seconds.

(2) WIDTH INITIAL PULSE is included because for most solenoids the pull at the beginning of the stroke is at a minimum but in-



Chassis supports the complete electronic equipment to operate the electromagnetic reciprocator solenoids. Controls are mounted at the front

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creases rapidly as the plunger enters the coil. The result is often a hammer-blow action that is undesirable. This effect can be minimized by initiating each pulse with a high starting current, the steady current for the remainder of the pulse being at a lower value. This adjustment controls the length of time the initial pulse persists (its amplitude control is described later). The adjustment provided is from about 0.05 to 0.5 second.

(3) Steady current value after initial pulse is designated SHELF HEIGHT on the nameplate under two control knobs. This adjustment controls the steady value of current following the initial pulse and, therefore, usually determines the pull, and in turn the speed, of the forward and back motion. When it is adjusted to maximum, the initial pulse disappears because the current during the whole stroke is essentially constant and at the maximum which is determined by the next described adjustment.

(4) Maximum current control is labeled THYRATRON BIAS because this is actually the method of current control. A change in the d-c bias on the grid of the output thyratrons changes the time during each 60-cycle period when the a-c firing voltage is effective. Thus, the maximum load current can be varied. This maximum applies to both the initial pulse and the steady current that follows; the values of both are varied and approximately by the same ratio. This adjustment also provides for the load characteristics of different coils used with the reciprocator. The control might not be necessary if the coil load were always the same size or rating.

Some of these adjustments are interdependent; that is, thyratron bias will also vary shelf height. In addition, if the cyclic timing is short, the initial pulse width may determine the average current though the coil more than shelf height.

In thinking about the circuits of a device of this sort, one should not confuse the 60-cycle wave shapes due to bias controls with the current forms fed into the electromagnetic coils.

In making adjustment of the reciprocator to give a desired sequence of current pulses, it has been found convenient to connect a lamp in parallel with the winding of each electromagnet. The flashing of these lamps gives a fairly accurate indication of the voltage variation applied to the magnet winding. A fine-wire filament lamp should be used to minimize power consumption and so that the change in illumination rapidly follows the change of voltage of the circuit. For the arrangement described, a 7½-watt, 120-volt frosted lamp has been found satisfactory.

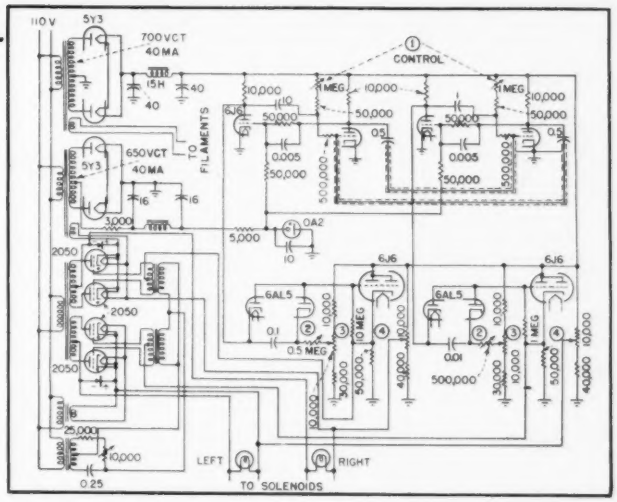

FIG. 1—Schematic diagram of the impulse-forming unit and the thyratron power amplifier unit. Numbers of controls in circles correspond to waveforms and text references

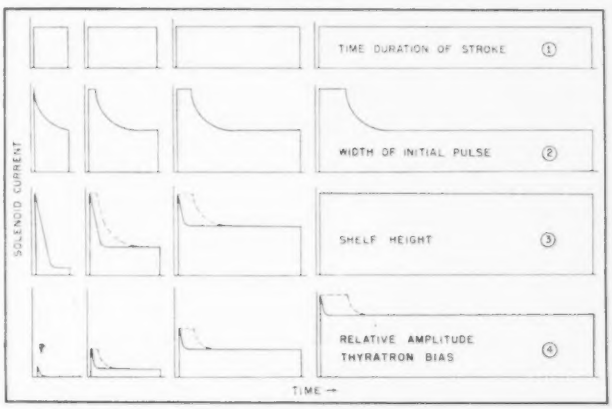

FIG. 2—Controls available for the supply of current to the solenoids. Graph numbers correspond to controls in Fig. 1

TV RECEPTION Below Line of Sight

Signals to a receiving point 2,000 feet below the line of sight are received with the aid of an 18-element antenna array, a cascode preamplifier at the antenna and special design of i-f amplifier stages and sweep circuits

By ROBERT B. McGREGOR

Station WHAS
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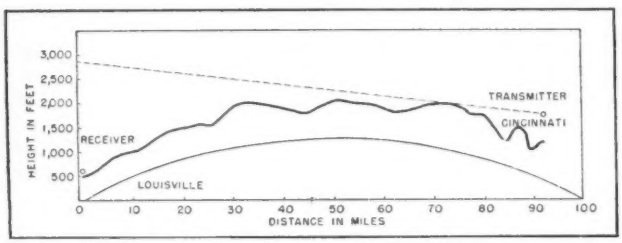


FIG. 1—Terrain between Louisville and Cincinnati, 92 miles apart

UNDER NORMAL CONDITIONS, the range of uhf transmitters may be extended by increasing the height and power[1] of the transmitter. Experimental evidence also shows that improving the receiving installation can add miles to the effective transmitter range[2,3]. Since the area of coverage is proportional to the square of the radius, an increase of a few miles in the radius will add considerable area.

In general, the receiving antenna problem is to build as much gain into the antenna as feasible and to place it as high as possible. Both gain and height are limited by practical considerations. The receiving site here in Louisville is a three-story brick building 92 miles distant from the WLWT transmitter on channel 4 in Cincinnati, Ohio. The intervening terrain is shown in Fig. 1. The receiving location is more than 2,000 feet below the line of sight.

The multi-element array was chosen as being most practical and it was decided to build an 18-element, three-bay, parasitic array. Each bay has 6 elements, 2 collinear driven elements placed horizontally with reflectors spaced 0.16 wavelength and directors spaced 0.1 wavelength. The use of collinear elements allows voltage feed to be used and narrows the angle of response in the horizontal plane. Voltage feed is preferred since it requires half the number of connections and half the number of feed wires as current feed. The physical layout is shown in Fig. 2.

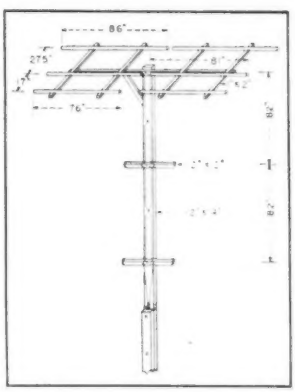


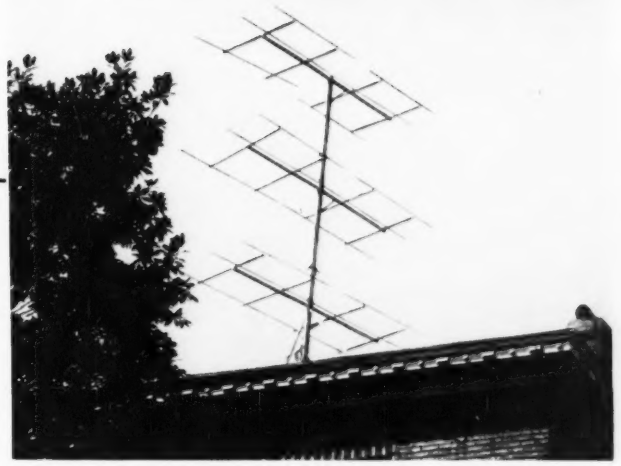
FIG. 2—Mechanical arrangement of one bay of the three-bay antenna

Antenna Measurements

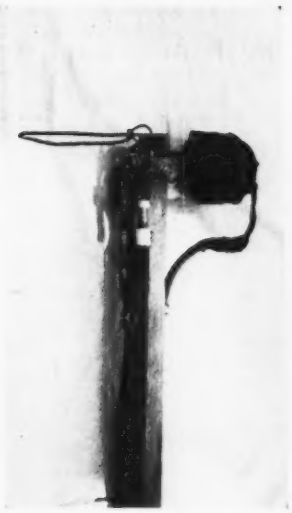
To check the dimensions of the antenna, one bay of 6 elements was set up in a clear space and measurements of field intensity and tuning were made using a variable-frequency oscillator, a standing-wave detector, and a field-strength meter. The variable-frequency oscillator used was a simple grid-dip oscillator. The standing-wave detector was an r-f bridge comprising the circuit shown in Fig. 3.

For the field-strength meter, also shown in Fig. 3, a loop about 8 inches in diameter was mounted on a 1 by 2 about 15 feet long. The loop is tuned by a small variable capacitor driven by a reversible motor. A 1N34 crystal is used for the detector and a 100-μa meter is the indicator.

To calibrate the bridge for standing-wave ratios, several carbon resistors were chosen which are multiples of 52 ohms. The oscillator was tuned to the frequency to be used and the bridge connected to it with 10 feet of RG 8U transmission



Eighteen-element array on roof of three-story building in Louisville



Loop for field-strength meter

line. The output of the bridge was unterminated and coupling to the oscillator very loose. The coupling was then increased until the bridge detector meter read full scale.

A length of transmission line was connected to the output of the bridge and the transmission line terminated with 100, 150, 200, and 250 ohms respectively. The meter showed the standing wave ratios of 2, 3, 4 and 5 respectively. The antenna was next set up with the remote-operated field-intensity loop 15 feet away. It is convenient to put the control switch and the microammeter close to the variable-frequency oscillator so that retuning of the oscillator, field-strength meter and reading of the standing-wave ratio is possible by one person.

The transmission line from the output of the standing-wave detector is connected through a quarter-wave matching section to the antenna. The matching section should be adjustable in spacing. By using this arrangement it is possible to match the transmission line to the antenna and adjust the elements of the antenna.

It is also informative to make a frequency run on the antenna. When doing this, it must be remembered that if the frequency is varied over a wide range, the standing-wave detector will show several minimums. However, the minimum at the correct frequency is quite broad and is a complete null.

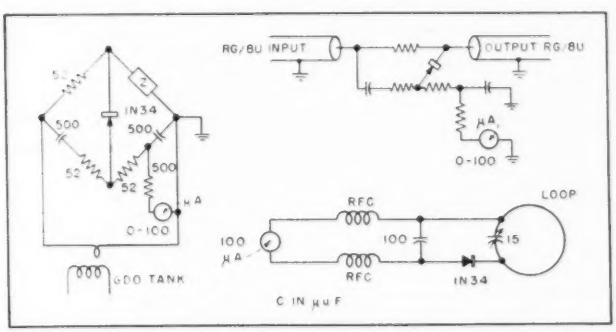


FIG. 3—Schematic and actual circuit of the standing-wave detector, and circuit of the field-strength meter

Since the feed impedance of the complete array is unknown, this is determined by using the standing-wave detector and adjusting the quarter-wave section for the null. The best match for the array described was secured by spacing the quarter-wave section $\frac{3}{4}$ inch at the low-impedance end and 4 inches at the high-impedance end. This unusual arrangement operated best, probably because no bazooka was used going from an unbalanced line to a balanced antenna.

Power Gain

If, in an array of elements, it is possible to determine from graphs or tables the mutual resistance and self resistance of all elements, the power gain may be easily obtained. To the resistance of each element is added the resistive component of the mutual impedance between all other elements. This was done for each element and then totaled to obtain the resistance of the array. For this array the resistance is 1,481.2 ohms. The resistance of a single element is 73.3 ohms. Assume a current I in each element. The power field produced is proportional to the square of the number of elements. With 18 elements, the field produced is 324 times the field from one element.

The power required to produce

current I is proportional to the resistance. So the power required, 1,481.2/73.3, is 20.5 times as great in the array to produce a field 324 times as great. Power gain is 324/20.5 which is 15.8, or 12 db.

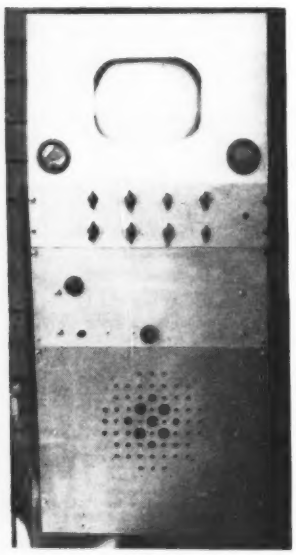
Booster Amplifier

To make the best use of the antenna, it is necessary to place an r-f preamplifier as close to the antenna as practical. In this installation, it is located on the roof of the building at the base of the array. This amplifies the signal fed to the downlead to the television receiver to overcome the noise in the receiver and also override the noise picked up on the transmission line. Since the loss in 100 feet of RG-8U, which is the transmission line used, is 1.8 db at 70 mc, the signal-to-noise ratio is improved. The Johnson-effect noise expressed in voltage is

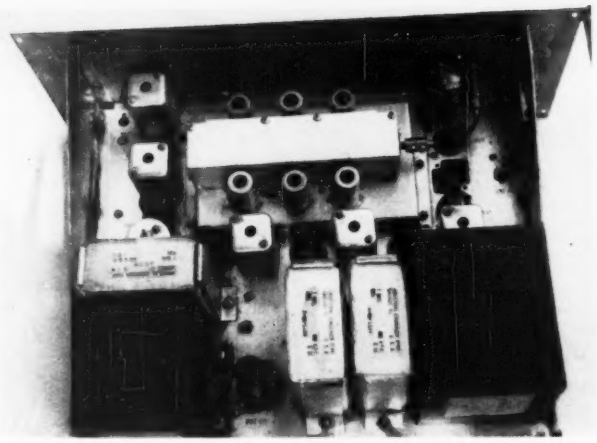
$$E^2 = 4\ KTR\ (f_1 - f_2)$$

where K is Boltzmann's constant, 1.37×10^{-23}; T is absolute temperature, 300 degrees; $f_1 - f_2$ is the bandwidth, 3×10^6; R is resistance, 52 ohms; then $E = 1.6$ microvolts.

This noise voltage and accompanying signal are stepped up by grid coil of the input tube. The proper step up for best noise factor is not an impedance match but also depends on the noise generated by the input tube. The tap on the input coil therefore is best determined by experiment.



The complete laboratory-type receiver contains a ten-inch picture tube and voltmeters for indicating the output of the regulated-sweep power supply and high voltage applied to the cathode-ray tube



Front-end and i-f stages of the receiver

The preamplifier circuit is the cascode.[4] This circuit gives excellent gain and stability; both factors are desirable for a remote amplifier. The noise factor at 70 megacycles is approximately 2 db better than other triode amplifiers. The schematic is shown in Fig. 4.

Circuit Adjustment

In adjusting the cascode amplifier, the grid-dip oscillator was used to tune the circuits.

The input circuit resonates at 94 megacycles without the 6AK5 in place. With the tube in the socket and no heater voltage applied, the circuit has a resonant frequency of 69 megacycles. The band pass is approximately 5 megacycles broad at 69 megacycles.

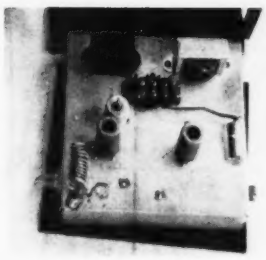
Measurements showed more than 15-db gain over the band. The high stability of the circuit may be attributed to the fact that the high-impedance input circuit is isolated from the high-impedance output circuit by the two tubes and a low-impedance common coupling. In spite of this, the circuit can oscillate with improper neutralization of the 6AK5, since it is connected as a triode. Proper adjustment of the neutralizing coil around the stage is accomplished by disconnecting one heater lead of the 6AK5 and tuning the coil slug for minimum signal. The method is the same as that used in neutralizing triode r-f amplifiers in old receivers.

I-F Response

To reduce the effect of noise appearing on the picture tube and its effect on the synchronization circuits, the i-f alignment is unconventional. The video i-f chassis consists of a surplus radar receiver type BC 1161-A with the second detector modified and with amplified age added. The five i-f stages are broadened by shunting with 7,500-ohm resistors and then stagger tuned.

The response curve is shown in the lower part of Fig. 5. By placing the video carrier on top of the curve, the amplitude of the carrier and adjacent frequencies is increased 6 db. The large detail of the picture is thereby improved while the high frequencies as represented by the small detail are degraded. Note also that the vertical sync pulses are amplified more than in the conventional system.

The front end of the radar set was removed and replaced with a front end constructed with a three-gang Mallory Inductuner using the circuit of Fig. 6. To adjust the oscillator for the tuner, the shunting capacitor is adjusted for the



Chassis of cascode preamplifier mounted at base of antenna array

low frequency and the end inductor squeezed until the high-frequency end of the range is correct.

The end inductors are placed $\frac{3}{4}$ inch apart and coupled opposing. Capacitor C_c is set to half value and C_A and C_B are adjusted to cover the low-frequency end of the band. The end inductors are adjusted to cover the high-frequency end of the band. The bandwidth at the low-frequency end is determined by C_c. The bandwidth at the high-frequency end is set by adjusting the distance between the end inductors (close spacing decreases the bandwidth).

The video amplifier consists of a 6AC7 and a 6AG7. An output of 0.1 volt from the video detector is sufficient for complete modulation of the kinescope grid, from black to 10 or 12 footlamberts. A 10-inch General Electric picture tube with aluminized coating on the phosphor was used.

The video amplifier includes a noise limiter to reduce the amplitude of ignition noise reaching the intensity grid of the cathode-ray tube. The noise limiter is a series diode which conducts as long as the plate is positive in respect to the cathode. However, with a high noise pulse the cathode is driven positive in respect to the plate, thereby limiting the amplitude of the noise pulse.

Sweep Synchronization

Phase synchronization is used in both horizontal and vertical sweep circuits[5]. The circuit of the phase-sensitive detector is shown in Fig. 7. The voltage from the sweep generator is fed in the same phase to a plate and cathode of the detector. The incoming pulse is fed as a negative pulse to the cathode and as a positive pulse to the plate. Thus, a shift in phase of the incoming

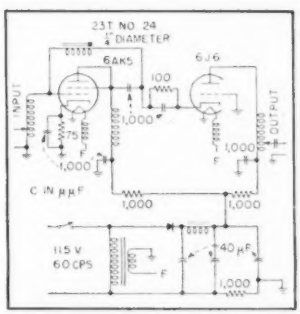


FIG. 4—Complete circuit of the cascode booster amplifier located at the base of the antenna mast. Other elements of the 6J6 are grounded

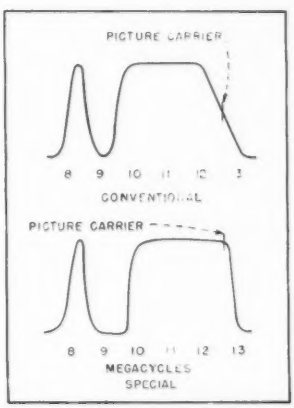


FIG. 5—Frequeny response of I-f stages with picture carrier placed on top of the curve

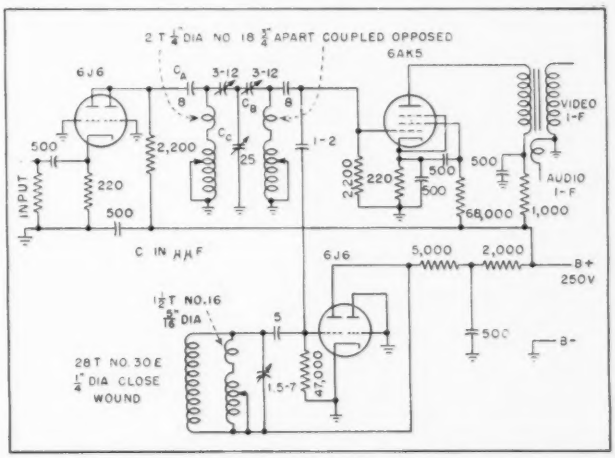


FIG. 6—Circuit of front end added to the radar receiver chassis

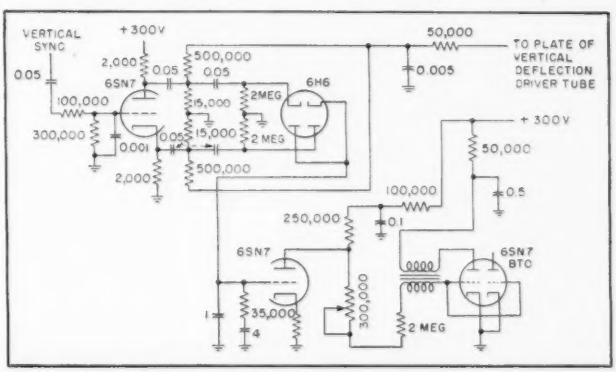


FIG. 7—Phase-sensitive detector and blocking oscillator circuit for vertical sweep

pulse will increase the current through one diode or the other, depending upon the direction of phase displacement.

The action is transmitted as a shift in d-c potential on the grid of the following tube. This tube acts as an amplifier feeding the blocking oscillator tube. The action on the oscillator is to adjust its speed until the incoming pulse and the sweep voltage are again balanced in the phase-sensitive detector.

A filter is arranged on the control voltage so that the oscillator does not follow rapid changes. This makes the circuit more impervious to noise. The sync circuits hold as long as there is a trace of a picture.

Most commercial models of television receivers are at present using effective horizontal phase synchronization but are still using pulse sync on the vertical sweep generator. In the presence of noise, this adds to the flicker. A burst of noise occurring at the time of a vertical pulse makes the picture jump vertically. Since phase sync with the accompanying filter responds to the average phase of the incoming pulse, the noise has little effect, partially because the noise has random phase relationship and does not repeat periodically.

Another important type of interference is caused by reflection of the television signal from planes. It starts with a slow flutter of the picture progressing to a very rapid flutter then gradually slowing and trailing off to a normal signal. It is necessary to use amplified automatic gain control to effectively counter this effect and to minimize fading signals. One stage of amplification is used as shown in Fig. 8.

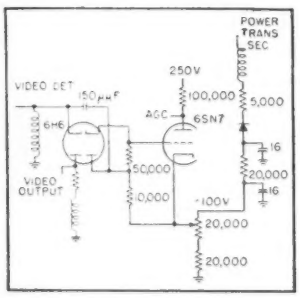
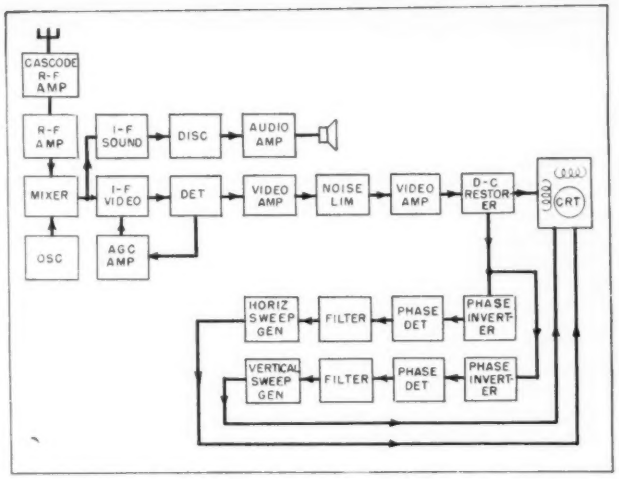


FIG. 8—Circuit of amplified-agc system. The selenium rectifier supplies bias



Block diagram of complete receiver from antenna to picture tube and loudspeaker

The blocking oscillator was selected for generating both horizontal and vertical sweep voltages because it is more stable than the multivibrator. The very close coupling and small inductance of the coil produces fast regeneration and a very sharp pulse that is easily timed and synchronized.

An electronically regulated power supply was used for the sweep circuits to provide regulation in respect to varying line voltage and varying load.

Results

With this installation, there have been times when WLWT came in as well as a local station. In general, most reception still left a lot to be desired. However, any time station WLWT was on the air they could be received.

Approximately 50 percent of the time the picture was entertaining. On a good night, the picture remained consistently good throughout the evening. Occasionally the picture would be good during the day and poor at night. More often it was the other way around. Some frequency-selective reception was noted; sometimes the sound was better received, sometimes the video.

No correlation between reception and weather could be made.

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(4) Henry Wallman, Alan B. Macnee, C. P. Gadsden, A Low Noise Amplifier, *Proc. IRE*, **36**, p 700, June 1948.

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Citizens Band SIGNAL GENERATOR

Construction details of a signal source designed to facilitate development work on the Citizens Band. The unit contains a tunable concentric-line resonator in a Colpitts oscillator circuit using a subminiature tube

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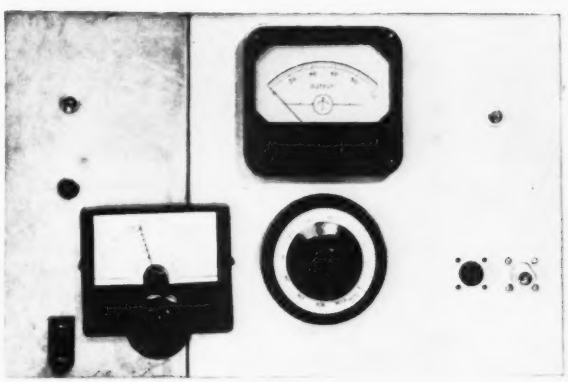
FRUSTRATION in developmental and experimental work at the Citizens Band frequencies due to lack of a signal generator caused the construction of the instrument to be described.

The complete generator forms a unit that may be built at a cost for components in the neighborhood of $100. It consists of an oscillator which may be grid modulated, a calibrated variable attenuator and a regulated power supply. The circuit diagram is given in Fig. 1.

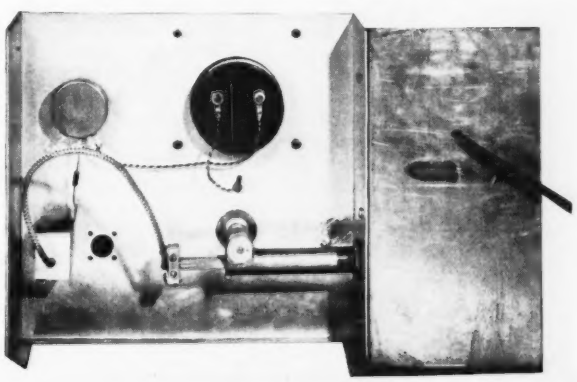
The generator contains a subminiature 6K4 tube in a Colpitts oscillator circuit. The tank circuit for this oscillator is of the concentric-line resonator type and is tuned by means of a variable air capacitor. The plate of the 6K4 shunt feeds the high side of the tank circuit.

A substantial part of the circuit inductance is contained within the tube and its plate and grid lead inductance. It is therefore necessary to keep the plate and grid lead lengths down to $\frac{1}{4}$ inch to obtain an upper frequency limit of 475 megacycles.

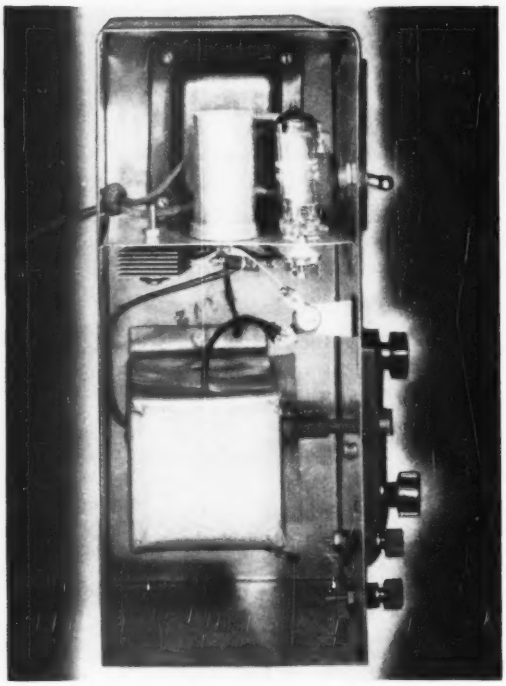
The cathode and filament are supplied through two self-resonant chokes which have been experimentally adjusted for best oscillator operation. The lead length is not critical. The oscillator may be externally grid modulated at the terminals shown. This connection



Panel of instrument after calibration



The oscillator-power-supply unit, at right, is attached to the attenuator side panel



Power supply and sheet brass shield of the oscillator

contains an R-C filter to prevent r-f leakage through the modulation circuit.

The oscillator is coupled through a wall in its resonator into a waveguide-below-cutoff attenuator. This is a Measurements Corporation model M-234 r-f attenuator.

Construction Details

The construction of the signal generator can be seen from the accompanying photographs. The oscillator and power supply are contained in a shielded sheet-brass compartment directly attached to the M-234 attenuator chassis. The oscillator is assembled within a separate shield can mounted within the main shield compartment. Figure 2 illustrates the construction of the oscillator and shield.

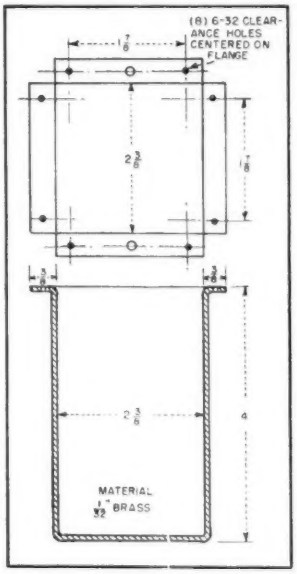
The oscillator resonator is constructed of machined brass parts and is of the coaxial-line type. The resonator is a first model of the output resonator for the transmitter described in the November 1947 issue of ELECTRONICS. As in the construction of any signal generator, all joints must be very carefully soldered to prevent leakage. It is realized, as has been the basic philosophy throughout this development, that most experimenters can do sheet-metal work but few can do machining; however no great ingenuity is required to make this construction using hand tools and butt-soldered joints. In addition, a little experimentation, using sheet metal resonators previously described by the author, should yield comparable results.

The power supply is mounted on a sheet-brass partition which is soldered to the main shield compartment. The grid connection is brought out to terminals on the front panel through an R-C filter. The tuning control for the oscillator is brought out to the tuning dial by means of an insulated shaft. The shielding of the signal generator is completed by means of a removable shield cover.

Frequency Calibration

The transmitter previously described was used in conjunction with a communications receiver and a 1N34 crystal to obtain the frequency calibration for the signal generator. Figure 3 illustrates the calibration method.

The output of the transmitter is used as a local oscillator for the crystal mixer which beats the frequency of the signal generator down to a low frequency which may be amplified and detected by the receiver. The receiver is tuned for the strongest signal obtained from the signal generator. The frequency at which the signal generator is oscillating is equal to 465 mc plus or minus the frequency to which the receiver is tuned. If the oscillator is started with the tuning capacitor set at full capacitance it will be op-



Details of oscillator shield can

CITIZENS BAND Articles

Transmitter	Nov. 1947
Receiver	Mar. 1948
Antennas	May 1948
Transceivers	Aug. 1948
Power Amplifier	Dec. 1948
Progress Report	June 1949
Wavemeter	Sept. 1949

R_1, R_3–1,000, 1/2 w

R_2–10,000, 1/2 w

R_4–680, 1 w

R_5–39, 1/2 w

C_1, C_2–12 $\mu\mu$f, silvered mica

C_3, C_4, C_6, C_7–100–1,000 $\mu\mu$f Erie button mica, type 370BB

C_5–30 μf, 350 v

L_1, L_2–11 turns No. 23, heavy Formvar, closewound on 1/2 watt, 100,000-ohm Allen-Bradley resistor

V_1–6K4

V_2–0B2

Y–75-ma selenium rectifier

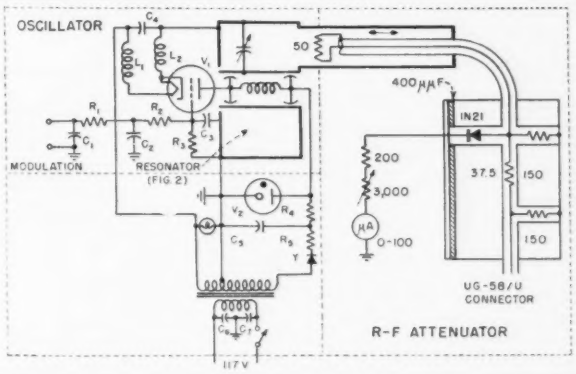


FIG. 1—Complete circuit of the generator

erating below 465 mc and as tuning is accomplished the frequency will increase. This method will supply complete frequency calibration data for marking the tuning dial.

This same setup was used to check the warm-up time and the plate-voltage stability. A check of the warm-up drift showed that the oscillator was within 0.5 mc below its final frequency of 473 mc within one minute. Complete stability was reached within five minutes. The plate-voltage stability was found to be 25 kc per volt.

The oscillator was modulated and tested using the receiver previously described (ELECTRONICS, March 1948). It was found that little frequency modulation was introduced, as evidenced by the decrease in audio output as the signal level of the signal generator was increased. The limiters in the receiver became more effective as the signal level was increased, reducing the effect of amplitude modulation. However, frequency modulation is undisturbed by this effect. Therefore it is believed that the residual frequency modulation of this signal generator is quite low.

The author appreciates the help of Jerry Mintner of Measurements Corp. who conducted tests of the final unit. A considerable electrostatic field was observed around the tuning dial and the shield cover joint and he suggested a length of tubing around the insulated tuning shaft, forming a waveguide attenuator; and bolting of the cover about every half inch.

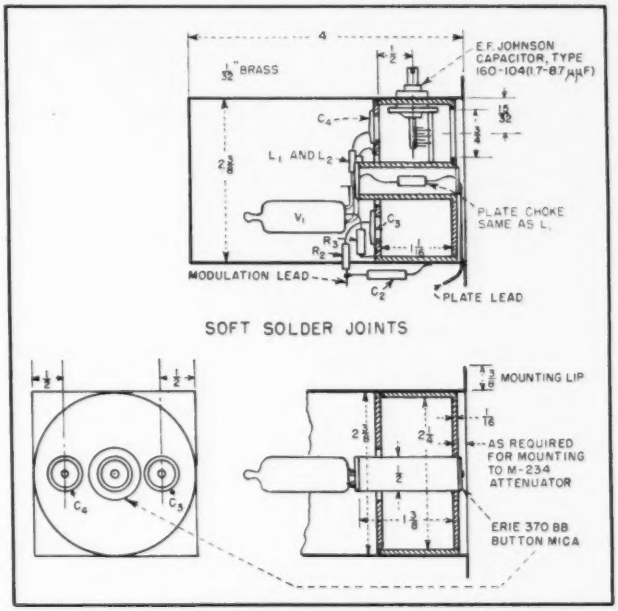


FIG. 2—Mechanical details of oscillator and shield

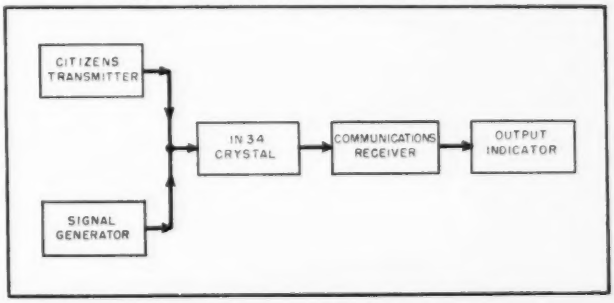


FIG. 3—Setup of equipment for calibration of generator

OPEN-WIRE

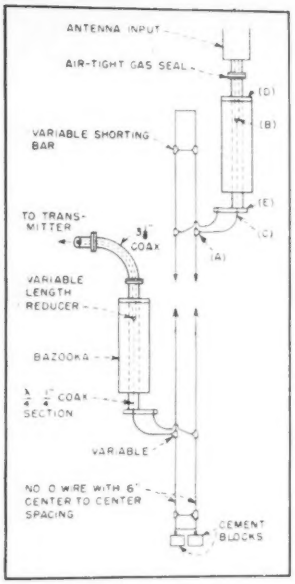


FIG. 1—Overall line and matching methods. Elements A through E are shown in detail in Fig. 2

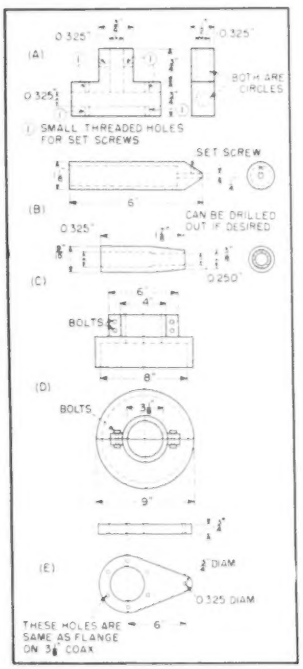


FIG. 2—Dimensions of the parts used for matching sections and line attachment

AT this station we have had a number of transmission line problems that may well be common to those faced by engineers in other f-m stations of comparable power. A solution to be described has increased the calculated effective radiated power from 31 to 36 kw.

When the station first went on the air at the present site in 1947 transmitter power of 1 kw was used although an increase to 10 kw transmitter power was contemplated. A 1⅝-inch coaxial line was purchased which was expected to carry 10 kw. However, when the 10-kw rig was connected to the line there was an arc-over and the standing-wave ratio climbed to 3 to 1. This condition was caused by moisture in the line. The importance of keeping the line air tight and under a small amount of pressure cannot be overemphasized. The line, which lasted only a few years, could have been used indefinitely had not this one little item been overlooked and had the line been inspected once a year.

Costs and efficiencies were calculated and it was decided to install a two-wire line. The efficiency for 1⅝-inch coax on the 240-foot run required was 88 percent, for 3⅛-in., 92.5 percent. For two-wire line, the efficiency calculated to better than 98 percent. Because of previous experience with 1⅝-in. and its efficiency the choice lay between 3⅛-in. and two-wire line. The cost of two-wire line was estimated to be $1,000 which was much lower than the 3⅛-in.

The construction of the two-wire line called for several approximations, for while text books give formulas for calculating quarter wavelengths, specific information on correction for different spacings, one-line size, and so on couldn't be found.

Number 0 wire spaced six inches was used for the line. By formula, $Z_o = 276 \log b/a$ so that for this case, $Z_o = 432$ ohms. The 10-kw transmitter and 4-bay antenna had output and input respectively of 51.5 ohms unbalanced to ground. The problem was to match the balanced two-wire line of 432 ohms to the 51.5-ohm unbalanced line. This was done by using a bazooka which is essentially a 1-to-1 transformer, for taking care of the balanced-to-unbalanced to ground condition and a quarter-wavelength coaxial matching section as an impedance matching device.

The necessary Z_o for the quarter-wave length transformer is the geometric mean between the Z_o of the two-wire line and the coax; $Z_o = (Z_o Z_o)^{\frac{1}{2}} = 149$ ohms. By using 3⅛-in. coax and a ⅜-in. bronze welding rod for a center conductor, the matching section was taken care of ($Z_o = 138 \log b/a$ which in this case gives 149 ohms).

Since the transmitter is only 30 feet from the tower, it was decided to mount a bazooka at both the top and the bottom instead of having a horizontal run. For running the two-wire line up the tower, braces were made at the top and the bottom variable from 25 to 30 inches from the tower (our frequency is 101.3 mc). The wire is threaded at the top and two holes of 0.35-in. diameter drilled in the top and bottom brace.

At the top, where the wire is threaded, four nuts are used. One is used at the underside of the top brace to hold a copper bar snug against the brace. Three nuts are used on top of the brace to give less chance of stripping the threads on the wire and letting it fall. At the bottom, after passing through the 6-inch-spaced holes on the brace, a 300-pound concrete weight is placed on each wire to keep it taut.

To maintain the wires the proper distance from the towers, and to prevent their swaying, quarter-wave shorted standoff insulators are used at staggered distances averaging 20 feet. If each insulator is separated by exactly the same distance a mechanical resonance may be set up during a bad wind-

LINE for F-M

Relatively inexpensive 240-foot untuned line feeds commercial 10-kw transmitter output to high-gain antenna. Installation is more efficient than coaxial lines of comparable power handling capabilities and is substantially unaffected by the weather

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storm causing the wire to vibrate. When these standoffs are exactly quarter-wave at the operating frequency they have a high impedance which is a pure resistance.

Half-inch bronze round stock was used, and for our frequency they were made 30 in. long, of which 8 in. was threaded. Then by drilling two half-inch holes 6 inches apart in a horizontal crosspiece of the tower, and by using two nuts, one on each side of the tower crosspiece, we had a variable quarter-wave standoff insulator. On the tower facing the line a copper strap, 8 inches long by 1½ in. wide with holes drilled identical to those in the tower, is placed. This gives a good low resistance short raising the Q and the effective impedance and providing a low-loss standoff. These were tuned with the swr meter in the transmitter. They can be calculated, however.

A perfect short would have to be 18 in. in diameter but the crosspieces of the tower don't even approach this figure. If the short is the same size as the material in the standoff then the six inches of the short has to be taken into consideration in the length of the standoff. With a perfect short, the standoff will be a quarter wavelength from the tower. When it was assumed that the crosspieces were a perfect short, this turned out to be true within the limits of experimental error. We used a velocity constant of 0.96 and the formula for a quarter wavelength in inches given by $2{,}950 \times V \, f_{mc}$.

When connected according to calculations, this line had an swr of 1.8 to 1. The change was made from the old 1⅝-in. coax to the two-wire line with no loss of time on the air. None of the different units was critical. With additional tuning the swr was brought down to 1.4 to 1.

Constructing the Bazookas

For best results the diameter of the bazooka should be two to three times the diameter of the coax. We used a diameter of nine inches. A bazooka isn't at all critical as to length; if designed for 100 mc it will work satisfactorily over the f-m band. For best results and lowest swr it should be adjusted to exact frequency. Flat copper sheet ⅛ in. thick and 30 in. wide was rolled and silver soldered for a diameter of 9 in.

Figure 1 (section D) and Fig. 2D show the construction of the bazooka short-circuit. The distance from the bottom of the bazooka to the connector (Fig. 1 and 2E) shouldn't be over two or three inches. The length of the bazooka from the short is calculated in inches by the formula $2{,}950 \times 0.96 \, f_{mc}$.

The 149-ohm impedance transformer was constructed as follows. A four-foot length of 3½-in. coax (outer conductor) was used which also is part of the bazooka. A length of center conductor equal to $(2{,}950 \times 0.96/f_{mc}) + 5$ inches was cut and the reducer in Fig. 1 and 2B inserted. To this is added the ¼-in. welding rod with the adapter reducer shown in Fig. 1 and 2C.

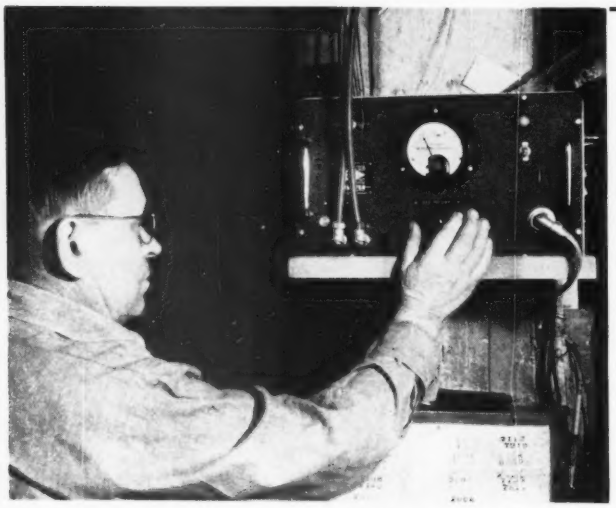
The ¼-in. welding rod should be silver soldered to the No. 0 line with the adapter (Fig. 2C) before starting any of the transformer construction. The connector shown in Fig. 1 and 2E is used to maintain the 6-in. line spacing. The two No. 0 wires, one from the connector in Fig. 2E and one from the adapter in Fig. 2C are connected to the two-wire line with the connectors shown in Fig. 2A

It is important to keep the leads from the bazooka to the two-wire line the same length and spaced 6 inches. The No. 0 wire leading from the connector (Fig. 2E) is threaded and a nut placed on each side of the connector.

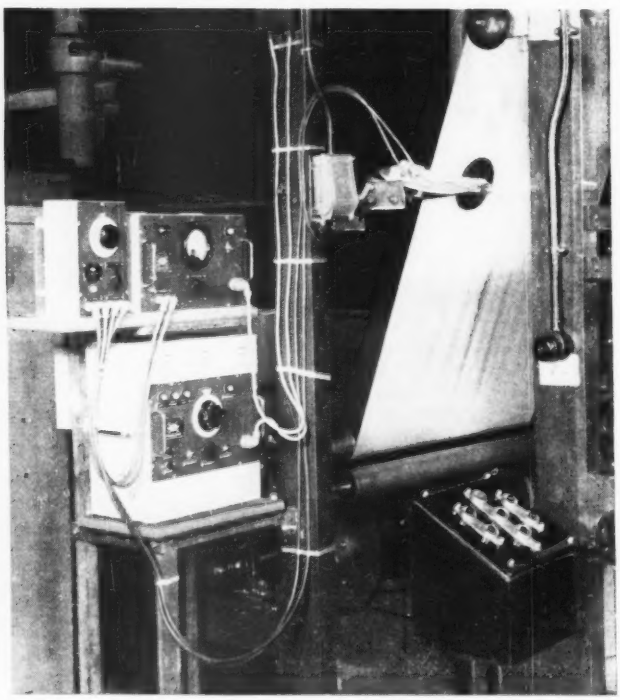
The matching section is supported by the use of a commercially available gas seal. Such a unit is generally placed between two lengths of coaxial line at the output of a transmitter. By this means, pressure is maintained up the exterior line even though in the transmitter building it isn't kept air tight. Besides holding up the impedance-matching transformer this unit also makes it possible to pressurize the antenna. On the flange in the gas seal used for joining the center conductors, a hole is tapped and a small set screw is placed through the center conductor of the coax into this tapped hole. The same method is employed with the center conductor and the reducer in Fig. 2B. The matching section is supported by tightening the set screw on the ¼-in. conductor.

Luckily, after the installation, we had a bad storm with plenty of rain, hail and a 50-mph wind. The swr did not vary at all. This particular transmitter kicks off automatically with an increase in swr or a short in the line. During the storm, the adjustment was set for closer tolerance than for normal operation and the transmitter didn't kick off once.

Automatic Control



Before automatic moisture-control unit was developed, an operator had to keep a pointer within desired moisture limits



Typical setup for automatic control of the moisture content of a fabric. The large cabinet contains the control unit which effectively reads the moisture-content meter (small cabinet) and automatically applies appropriate correction to dryer

By RALPH V. COLES

Vice-President
Fielden Electronics, Inc.
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DURING THE PROCESSING of textiles it is often necessary alternately to wet and dry the fabric as it proceeds continuously between operations. Until recently there has been no accurate way to measure moisture content of cloth as it passes from the drying machine, so the tendency in the industry is to dry the fabric far beyond its normal moisture content to ensure at least adequate drying. The moisture content actually desired in fabrics varies from 2 percent in nylon to 14 percent in wool.

Moisture Detection

Several years ago an instrument called the Drimeter was introduced in English textile mills, and later in paper mills. It was capable of measuring the moisture content of a moving strip of fabric, but the reading of the meter had to be interpreted and the proper correction to dryer speed had to be made by hand in a separate operation. The control unit described in this article uses the above-mentioned unit as a measuring instrument and provides fully automatic control of moisture. It takes complete charge of the drying machine, replacing the judgment of the operator. The equipment makes corrections proportional to error in moisture content at time intervals inversely proportional to machine speed and integrates moisture content over a period of 2 or 3 seconds, or longer if necessary, before initiating a correction. It becomes quiescent as soon as there is no fabric between the electrodes of the measuring element or if the machine stops. Following a stoppage, it will deliver all over-dried material from the machine before it initiates corrections in machine speed.

It is well known that a variation

# of Moisture

Electronic equipment makes corrections proportional to error in moisture content as material passes through measuring element. This type of control is especially applicable to the textile and paper industries

in the moisture content of a hygroscopic material is accompanied by a change in its electrical properties. This variation provides a basis for continuous moisture estimation, either by measuring the change in electrical resistance or by measuring the dielectric constant.

Instruments in the textile and paper industries which are designed to measure the variation in electrical resistance of the material are limited by the need to establish and maintain electrical contact with a rapidly moving fabric or paper, change in resistance due to different dyes and filling materials and variations in the acidity or alkalinity of the processing liquids. On the other hand, an instrument which measures variation in dielectric constant may have to deal with a very small mass, even a single thread, and must be capable of measuring the small increment in electrical capacitance with accuracy and stability.

The Drimeter operates on the latter principle, and tests in textile mills show that it is accurate within plus or minus one percent. The instrument consists of an electronic hygrometer which indicates the moisture content of the yarn or fabric instantaneously and continuously on the panel, and a capacitor consisting of a mounting arm and two plates between which the yarn or fabric passes. The capacitor and the hygrometer are connected by two r-f coaxial cables which may be up to 30 feet in length.

Automatic Control Requirements

The problem of automatic control of drying equipment is complicated by the delays which are inevitable between a correction in machine speed and a change in moisture content. If a correction is continued until the moisture content reaches the desired level, the result would normally be over-correction, resulting in hunting.

Corrections cannot be spaced according to a fixed time, since the speed of a textile drying machine may vary in the ratio of 6 to 1 or greater. Hence, corrections based on a fixed time interval may be too frequent, causing hunting; while corrections made too infrequently cause reduction in machine efficiency. Therefore intervals between corrections must change according to the speed with which the machine is running.

The mechanism which provides the timing of the intervals must be initiated by an error in moisture content. If it is merely timed at fixed intervals, a considerable quantity of wet or dry material can be delivered from the dryer if a correcting period has just passed. Also, the control must ignore momentary wet patches. In other words, the device should integrate over a period of 2 or 3 seconds.

If the drying machine stops for some reason, a considerable length of material may be over-dried, and the control mechanism must not initiate corrective measures until after the over-dried fabric has passed from the drying machine.

The control should make corrections in proportion to the extent of the deviation from the desired moisture content, and should become inoperative when the machine is stopped, or when there is no material between the electrodes of the measuring element.

A block diagram showing a complete automatic drying-control setup is shown in Fig. 1. The wet fabric or paper enters the drying machine from the left, and as it emerges it passes through the measuring electrodes and onto a reel or some subsequent process. The tachometer alternator signal and the signal from the moisture-measuring unit are combined in the automatic control unit which is to be described. The automatic control unit relays control a small reversing motor which is connected to the drying-machine speed control.

In the application of automatic control to paper machines, simpli-

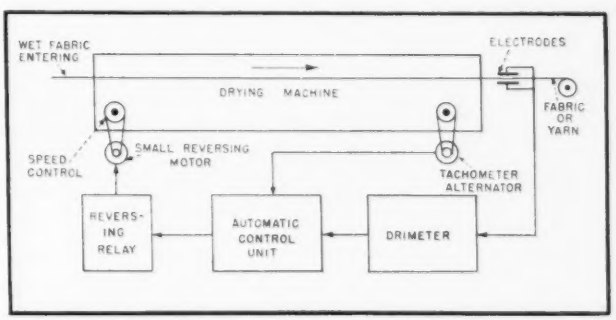


FIG. 1—Block diagram of automatic-control setup. The unit has two inputs: the signal from the moisture-measuring element, and a signal from the tachometer alternator which is proportional to drying-machine speed

fication is in order as it is possible to employ some degree of prediction in order to maintain constancy of output. This is not possible in the textile industry due to the nature of the machines. For example, by monitoring the moisture content at more than one point on the drying machine, and controlling the temperature at different sections of the machine, closer control will probably be obtained than by limiting monitoring and controlling only to the output. The control may not require such a long period of integration before initiating a correction. It may also be possible to eliminate the proportional feature and the varying interval between corrections.

In the application of automatic control to paper making machines, speed control cannot be employed and control of pre-extraction, temperature or squeeze roll pressure must be adopted.

Circuit Details

To operate the automatic control unit, two variables are fed to the instrument: (1) a voltage which varies in proportion to moisture content, and (2) a voltage proportional to machine speed, derived from a small alternator driven by a moving shaft of the drying machine.

The output voltage of the Drimeter is an alternating voltage with a frequency of approximately 500 cps, which varies in amplitude with the moisture content of the material being fed through the electrodes. As shown in the automatic control unit circuit diagram in Fig. 2, the variable a-c voltage is applied across a potential divider which provides a means for adjusting the voltage input of V_1 to a standard amplitude, selected by the MOISTURE LEVEL control knob on the front panel of the instrument. The two 50,000-ohm variable resistors in the divider provide a means whereby the moisture scale may be expanded or contracted to agree with the instrument calibration.

Tube V_1 is an amplifier in the anode circuit of which is connected an output transformer provided with three separate secondary windings. The first winding is in series with the cathode circuit of the tube, and provides negative feedback to stabilize the stage gain. The second winding is center-tapped and provides two equal but antiphase voltages at the suppressor grids of tubes V_2 and V_3. The 2-megohm suppressor-grid resistors prevent grid-current damping of the voltage source during positive half cycles. The third winding provides a voltage at relatively low impedance to the bolometer bridge network.

The out-of-balance voltage from the bridge is fed via a resistance-capacitance phase-correction circuit to the grid of V_2, which together with V_3, provides a two-stage voltage amplifier of conventional design. Negative feedback is provided from the plate of V_3 to the cathode of V_2. The output from this amplifier is used for two purposes: (1) It is fed to the diode V_{5B} to provide a voltage across the diode load proportional to the out-of-balance voltage of the bolometer bridge (error in moisture content). (2) The output from the amplifier is also taken from the slider of a potentiometer through a transformer to the control grids of V_5 and V_6. The amplitude of the a-c component at these grids is adjustable by the potentiometer in the plate circuit of the amplifier, which provides the TOLERANCE control of the instrument. The d-c bias of V_5 and V_6 is adjustable by the potentiometer in their common cathode return.

Operation

If the output of the textile drying machine is at the required moisture-content level, a voltage will be present at the input terminals of the circuit which bears an amplitude relationship to this moisture content. The moisture level dial is adjusted to provide an input volt-

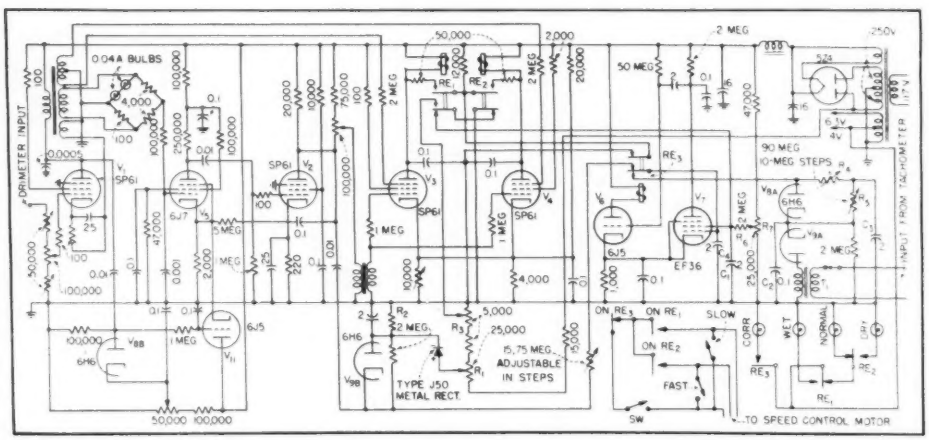


FIG. 2—Schematic of automatic-control unit for moisture control. Where available, American equivalents have been substituted for British tube types in the diagram

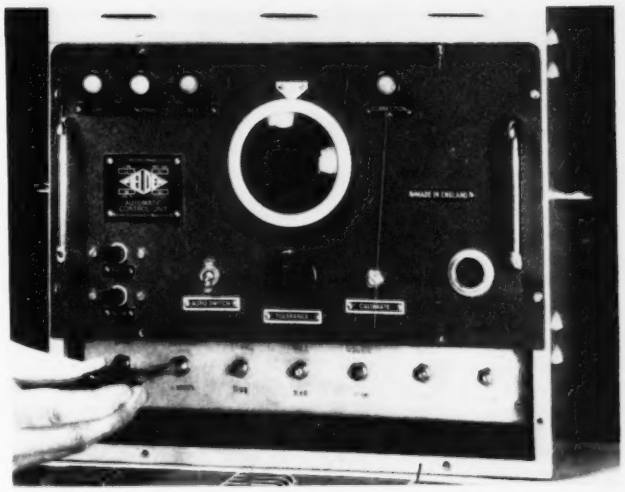
age on the grid to V_1 of such amplitude that the bolometer bridge is balanced. As this type of bridge will only balance at one amplitude of input voltage, there is no out-of-balance current present at the bridge. The input voltage to amplifier V_2 and V_3 is zero, and there is no a-c component present at the control grids of V_3 and V_4. The bias on both suppressor and control grids of V_3 and V_4 is adjusted so that they are not conducting, and RE_1 and RE_2 are de-energized.

With a change in moisture content, the amplitude of the input voltage will unbalance the bolometer bridge, and an a-c voltage will appear at the grids of V_3 and V_4. The phase relationship of this voltage to the voltage already in existence at the suppressor grids will depend on which way the bolometer bridge is out of balance. Either V_3 or V_4 will become conductive according to which tube has its two grids in phase. If the material is too damp, relay RE_1 will be energized; if too dry, RE_2 will be energized, and a voltage will be present across V_{3B} having an amplitude proportional to the out-of-balance voltage of the bridge, or the error in moisture content.

The operation of RE_1 or RE_2 will determine which way the correcting motor will run; however, the motor will not yet start as RE_3 is still energized. Relays RE_1 or RE_2 will also change the green light on the front panel for the appropriate wet or dry red light. The energized relay (RE_1 or RE_2) will be locked in when RE_3 is de-energized. Finally, when either relay RE_1 or RE_2 is energized C will start to charge through R_{11}.

If the moisture content has increased and the wet relay RE_1 operates, a portion of the potential across the voltage-divider network containing R_1 will be short-circuited, thus lowering the voltage at the slider of R.

An a-c voltage, proportional to machine speed, is fed to transformer T. Taps on this transformer provide a means by which the amplitude of the input voltage to the circuit can be adjusted in the initial timing of the equipment. The voltage is stepped up by the transformer and rectified by V_{5A}; thus across C_2 there exists a d-c voltage which is positive relative to ground, and proportional to machine speed.



Adjustments for different types of material are accessible through a removable section on the front panel of the automatic control cabinet

This voltage is connected to C_3 by a high resistance R_{12}, thus across C_3 there also exists a voltage proportional machine speed. This voltage is made available to C_4 through another high resistance, and a contact on RE_3. The diode V_{5A} discharges C_4 if the machine is stopped.

Tubes V_3 and V_4 and their associated components form a cathode-coupled quiescent asymmetrical multivibrator of unconventional design. The plate current of the triode V_{3A} with a comparatively low resistance in its plate circuit, is many times greater than the plate current of the pentode V_4 with its high-resistance plate load; thus, the potential across their common cathode resistor, which determines the cathode potential of both tubes, is determined by the plate current of V_{3A}. In the quiescent state, the screen of V_4 is grounded, and the tube is nonconductive; V_{3A} is conductive, and RE_3 energized.

A 60-cycle voltage is taken from the high-voltage secondary of the power transformer and reduced in amplitude by the potential divider containing R_{13}. This voltage is rectified by a metal oxide rectifier and appears as d-c voltage across R_{13}. The circuit is arranged so that the bottom end of R_{13} is negative relative to ground.

It has already been shown that across V_{3B} there appears a voltage proportional to the error in moisture content, and this voltage is arranged to oppose the voltage across R_{13}. Thus, between the cathode of V_{3B} and ground, there exists a negative voltage which is reduced in proportion to the error in moisture content.

Circuit Details

When there is a discrepancy in moisture content, RE_1 or RE_2 operates, and C_1 starts to charge through R_{11}. Nothing will happen until the screen potential of V_4 has risen to the level at which the tube can operate. The period of this delay is adjustable by R_7 and allows momentary wet patches in the fabric to pass without correcting machine speed. If, during this 2 or 3 second interval, relays RE_1 or RE_2 have returned to their normal position, C_1 will be discharged and nothing will happen.

If the discrepancy has lasted longer than the time delay C_1R_{11}, V_4 will start to conduct. The plate voltage of V_4 will fall, reducing the

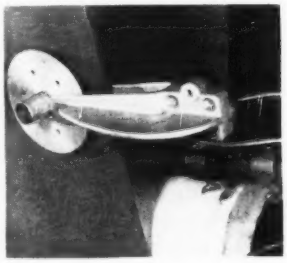
grid voltage of V_{8a}. Thus the plate current of V_{8} will fall, and the cathode voltage of V_{7} will fall in relation to its grid. This process further increases the plate current of V_{7}, and the whole action becomes regenerative until V_{8} is biased beyond cutoff, and V_{7} is fully conductive. Relay RE_{3} is deenergized.

The operation of RE_{3} starts the correction motor. It also switches the grid of V_{7} and locks the position of the other relays while the motor is running. It also lights a lamp on the front panel of the instrument. The motor will now continue to run until V_{8} can again conduct.

Prior to operation of RE_{3}, C_{4} held a positive charge of approximately 25 volts. This charge was obtained from C_{2} through R_{11}, and limited to the stated value by the cathode potential of V_{7}. When RE_{3} operates, V_{8} is cut off, and the cathode potential is reduced to very nearly zero. At the same time, the potential of the grid of V_{7} is also reduced to nearly zero by the discharge of C_{4} through the tube. The circuit therefore remains in this state until the grid of V_{8} is biased beyond cutoff.

The time constant of the r-c network in the grid circuit of V_{8} is much longer than the required operation time of the circuit, and the grid potential of V_{8} can be dismissed from consideration. The grid of V_{7} was transferred by RE_{3} to a stepped variable resistance which is connected to the cathode of V_{10}. A voltage is present at this point which varies inversely to the error in moisture content, being of greater amplitude on dry errors than on wet errors. The degree of difference in amplitude is adjusted by R_{2} which provides greater correction on wet errors than on dry errors. Capacitor C_{4} will start to charge in a negative direction, and the grid potential of V_{7} will arrive in due course at the cutoff point. This time of charge will be inverse to the applied voltage and proportional to the error in moisture content, and it will differ between dry and wet errors. If a large correction in moisture content initiated by a large error should disappear while the correction is being made, the motor will stop quickly due to the disappearance of the voltage across V_{10a}, causing the full voltage across R_{2} to be applied to the r-c network feeding the grid of V_{7}.

As soon as the grid potential of V_{7} arrives at a value where V_{7} starts to cut off, the plate voltage rises, the grid voltage of V_{8} rises and V_{8} starts to conduct. The cathode voltage of both tubes rises, further reducing the plate current of V_{7}. The whole action is again regenerative until V_{7} is completely cut off, V_{8} completely conductive and RE_{3} energized. By this action, the motor ceases to correct, the lamp on the front panel is extinguished, the interlock is removed from RE_{1} or RE_{2}, and the grid of V_{7} and C_{4} is returned to R_{11}. The circuit remains in this condition until the grid of V_{7} is lifted from a few volts negative to ground to a potential approaching the cathode which is now at some 25 volts positive to ground.



Moisture-sensing electrodes. Capacitance between circular plates varies with amount of moisture in fabric

Capacitor C_{4} first loses its negative charge and then starts to charge positive through the high resistance R_{11}. The time of this charge will depend on the choice of the value of R_{11} and inversely on the amplitude of the voltage present across C_{4} which is proportional to machine speed. Thus, the circuit is quiescent for a period of time which varies with the speed of the machine.

At the end of this period, when the correction to the speed of the machine has not been effective in restoring the required moisture level, V_{7} will again conduct and make another correction proportional to the error. On the other hand, if the correction has been effective, the bolometer bridge will have been restored to balance and V_{7} will be rendered inactive by the dropping out of RE_{1} or RE_{2}.

If the drying machine is not running, the grid potential of V_{7} can never rise, and the circuit can not operate. The diode V_{9d} is provided to discharge C_{4} and C_{3} if the machine is stopped. Thus, the circuit is rendered inoperative until C_{3} has been recharged through R_{5}, and C_{4} has been recharged through R_{11}. The time constant $C_{4}R_{11}$ gives suitable time intervals between corrections. The time constant $C_{3}R_{5}$ gives an extra time lag if the machine has been stopped. This allows for the delivery of the over-dried material. This time will also vary with machine speed.

If the electrode gap of the instrument contains no material, the input voltage to the control will fall, and it will proceed to make corrections for too dry. This is prevented by the muting tube V_{11} and the diode V_{9b}. A d-c voltage proportional to input voltage is derived from the anode of V_{1} via the diode V_{9a} and is used to bias V_{11} to cutoff. When the input voltage drops below DRY on the scale, this bias is reduced, V_{11} becomes conductive, and the cathode of V_{5} is lifted to a level to paralyze the bolometer amplifier.

Production Savings

By eliminating over-drying it has been possible in one particular installation of this type of automatic control to speed up the drying machines and increase production 25 to 30 percent. In this plant, 32 machine-hours a day have been saved, representing savings of $400.00 a week in wages alone. Eight men and women have been made available for jobs in other sections of the plant. The plant engineer estimates that steam consumption has been cut 20,000 pounds a day at a saving of about $12.00 a day.

Of even greater significance is the improvement in the finished fabric. Customers who do not know that moisture-control instruments are used have nevertheless noted that finishes have been improved and that the fabrics seem to have better texture.

Experimental Tube for F-M Detection

Beam-deflection type exhibits high sensitivity and a-m/f-m rejection, but small audio output. Performance characteristics are compared to detectors using conventional tubes. Experiments indicate feasibility of ten-fold improvement in characteristics by proposed design changes

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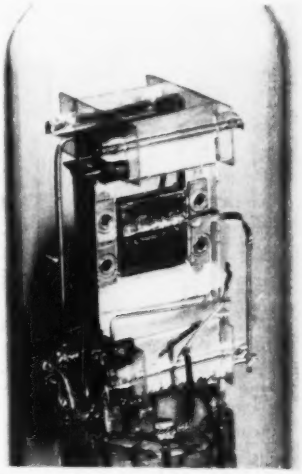
THE APPLICATION of a single-tube locked-in oscillator to f-m detection has been described in the literature.[1] The circuit, shown in Fig. 1, employs a grid-controlled multigrid tube, such as the 6SA7, as a 1-to-1 locked-in oscillator whose frequency is caused to follow the frequency of the input signal by means of an electronically derived reactance arising from the plate current suitably coupled back to the oscillator coil. In order to keep the oscillator synchronized to the input signal frequency, the plate current changes proportionally to the frequency deviation, thereby simultaneously giving rise to the audio output signal.

In order to realize optimum performance from this circuit, the current flowing beyond grid 2 should not affect the oscillator circuit except via the feedback coupling loop. Stated differently, a high degree of isolation is required between the oscillator grid 1 and the input signal grid 3. In this respect conventional multigrid tubes fall short of the desired characteristics. A special multigrid tube developed expressively for this circuit, the FM-1000, still does not provide good enough isolation to permit the employment of a high-impedance input circuit. To provide better isolation between input signal and oscillator circuits a combination beam-deflection and grid-controlled tube was developed.

In a conventional multigrid tube, coupling between input signal and oscillator circuits takes place in the forward direction because of capacitance between grid 1 and grid 3, circuit capacitance, and because the flow of electrons through the tube causes induced charges to appear on grid 3 (known as space-charge coupling).[2] Coupling in the reverse direction from grid 3 to grid 1 is due to the same first two factors and also because some of the electrons are returned from the vicinity of grid 3 to the vicinity of grid 1.[3]

The space-charge coupling in the forward direction between grid 1 and grid 3 is perhaps the most serious of these factors. There does not



Close-up of experimental beam-deflection tube elements

Table I—Comparison Data for Several Different F-M Detectors and Experimental Beam-Deflection Tube Detector

Tube	Output Audio ± 30 kc (volts rms)	Input Signal Impedance (ohms)	Minimum Volts (rms)	Minimum Power (mw)	A-M F-M Rejection Max. (db)	A-M F-M Rejection Min. (db)
6SA7	26.5	1,500	1.5	1.5	−37	−20
6SB7Y	22.3	1,500	1.1	0.8	−17	−29
FM-1000	37.0	1,500	2.2	3.2	−17	−35
Measured B-D Tube	7.2	100,000	0.1	0.0016	−19	−32
Proposed Improved B-D Tube	35.0	100,000	0.1	0.0016	−62	−46
	(Estimated for a five-fold increase in average output current)					

appear to be much that can be done to reduce this factor in conventional tubes; consequently the use of a low-impedance input circuit is indicated, with the consequent loss in gain from the driving stage. One method of circumventing this difficulty is to operate two tubes with their No. 1 grids connected in parallel and No. 3 grids connected in push-pull with suitable conversion from a push-pull anode circuit to the single-ended oscillator circuit. The electrons going outward from the cathode now induce in-phase currents in the No. 3 grids so that there is no net effect on the push-pull circuit.

Another method of achieving a balanced input circuit is to use a tube affording a combination of grid and beam-deflection control as indicated in Fig. 2. Other advantages that accrue from the use of such a tube are: negligible capacitance between grid 1 and deflection plates (signal electrodes), negligible backward coupling since returned electrons are eliminated, and single-ended output.

Beam-deflection tubes, whose general construction can be ascertained from the scaled cross-sectional view shown in Fig. 3 and the photograph, were constructed and mounted on conventional octal bases. In order to expedite construction, the frame and general construction techniques employed in other beam-deflection tubes[1] were utilized. Design constants are as follows: cathode, 0.025 in. x 0.053 in. wide; grid, flat, 45 t.p.i., 4.1-mil wire, 0.054 outside dimension; aperture, 0.050 in. wide x 0.320 in. long; and deflection plates, 0.362 in. wide x 0.362 in. long, spaced 0.090 in. apart. Except for limits imposed by mechanical design, the deflection plates could have been longer than 0.362 inch as transit time is not significant at the signal frequencies used. Static characteristics of the beam-deflection tube are shown in Fig. 4.

In order to evaluate the performance of the beam-deflection tube in the Bradley f-m detector circuit, shown in Fig. 1, data were taken using 6SA7, 6SB7Y, FM-1000, and special beam-deflection tubes. In view of possible application to carrier-difference television sound reception[2, 3], measurements were made at a center frequency of 4.5 mc and maximum deviations of 30 kc.

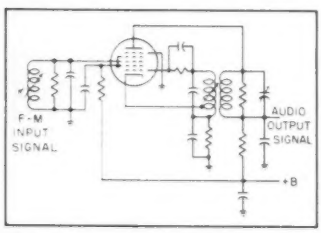


FIG. 1—Diagram of Bradley f-m detector circuit for use with such multigrid tubes as the 6SA7

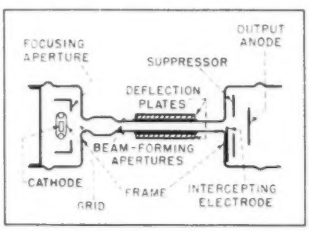


FIG. 3—Cross-section of beam-deflection tube elements approximately 1.4 times actual size

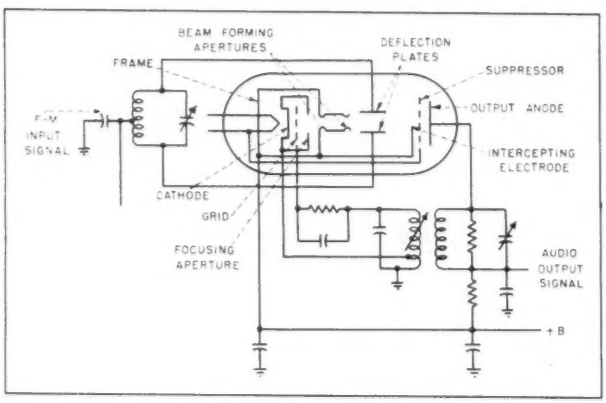


FIG. 2—Experimental tube circuit using combination of grid and beam-deflection control for f-m detection

Circuit Performance

The f-m and a-m output of these tubes, particularly as a function of the center frequency of the input signal, is of considerable interest. Using different tube types, data plotted in Fig. 5 were taken of the audio output as a function of the frequency of the input signal first with the input signal frequency modulated a fixed amount (± 5 kc, and second with the input signal amplitude modulated 30 percent; the input signal level was maintained at a value previously determined as just sufficient to maintain lock-in for an input signal frequency modulated ± 30 kc. Data for the 6SA7 tube are omitted since they are similar to 6SB7Y data.

The f-m response for ± 5-kc deviation is approximately a measure of the slope of the response curve at the average frequency and should of course be sensibly constant over the locked-in portion of operation; it is not quite constant because the circuit was not adjusted for maximum linearity but rather for maximum lock-in range for minimum signal input. Better linearity is possible at the sacrifice of a slight amount in lock-in range for a given signal input. If the circuit were operating ideally, there would be minimum a-m response when the center frequency of the input signal coincided with the oscillator frequency. Due to fortuitous coupling, the 6SB7Y and the FM-1000 (to a somewhat lesser extent) show minimum a-m response a little off center. The beam-deflection tubes indicate a somewhat more symmetrical a-m response.

Table I gives the maximum and minimum ratios of a-m response (30 percent modulation) to f-m response (± 30-kc deviation), together with other pertinent data for different tubes when adjusted for minimum input signal, the input signal level being just sufficient to maintain lock-in for ± 30-kc devi-

ation. Since the coupling in the forward direction from grid 1 to the signal electrodes (deflection plates) has been virtually eliminated in the special beam-deflection tube, it is now possible to operate with a much larger input signal impedance (estimated at 100,000 ohms as compared to 1,500 ohms used for conventional multigrid tubes). For optimum circuit performance, careful balancing of the input circuit is necessary.

Proposed Improvements

Table I also indicates the performance expected from an improved beam-deflection tube, assuming only a five-fold increase in output current, although a nine-fold increase is believed readily feasible by changes in design and the addition of a stage of electron multiplication.

The estimates for the proposed improved beam-deflection tube were obtained in the following manner. A five-fold increase in average output current produces a potential five-fold increase in variational reactance. This potential increase is realized for the same input signal and produces in turn a five-fold increase in audio output. The electronic reactance required to maintain lock-in remains the same however and, since the reactance is proportional to coupling between output circuit and oscillator circuit, a decrease in coupling is possible. The 14-decibel change in a-m f-m rejection is the result of the five-fold increase in the f-m audio signal with the a-m audio signal remaining constant.

The above mentioned assumption appears justified by virtue of the fact that the a-m signal is produced because the input signal affects the oscillator. Inadvertent coupling between input and oscillator should not be altered materially with the five-fold increase in output current. In fact, some reduction in a-m audio signal is to be expected from the decrease in intentional coupling possible; this reduction has not been included in the above estimate.

In the application of the special beam-deflection tubes to the detector circuit, due to the small output current, the tube has to be operated into regions of deflection non-linearity in order to produce lock-in for a ±30-kc deviation. As a consequence, the amount of a-m response is also a function of the input signal level. It is generally found that the a-m response goes through two minima as the input signal level is increased. The first minimum is believed due to an out-of-phase signal detection contribution produced by deflection nonlinearity, while the second minimum is due to a similar contribution produced by the electron beam striking the deflection plates. In the latter case the f-m response begins to suffer also. Nonlinearity of deflection control is tolerable, and in fact partly desirable, as long as the characteristic is skew symmetrical, or S shaped, as saturation at both ends of deflection produces an amplitude-limiting action. It appears that as long as the deflection characteristic is perfectly skew symmetrical, a-m response should be largely independent of input signal level.

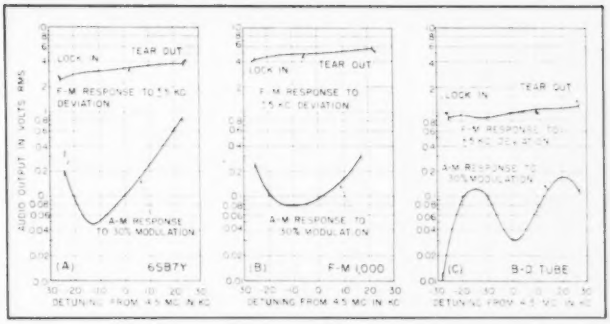


FIG. 5—Performance characteristics comparison for circuits containing 6SB7Y (A), FM-1000 (B), and experimental beam-deflection tube (C)

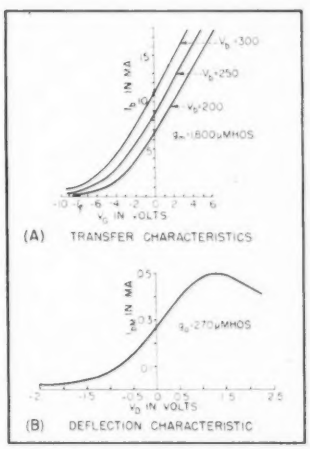


FIG. 4—Static characteristics of beam-deflection tube

Conclusions

Tests performed on the tubes constructed so far indicate the desirability of improvements and modifications in design in order to achieve optimum operating characteristics. Proposed improvements and modifications would increase the output current by employing improved electron optics together with a higher perveance triode input.

In addition to the Bradley f-m detector circuit, it appears likely that a tube of the type described herein might also have other applications such as a converter with low oscillator radiation, frequency stabilization and synchronization, dual control and coincidence circuits.

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DARKROOM

Sensitive phototube unit samples light falling on enlarging easel and gives optimum exposure time directly in seconds. Facilities are provided for using enlarging papers of different photographic speeds. Complete construction details are given

MEASUREMENT of average illumination on a photographic subject is common practice to most photography enthusiasts and professionals. The instrument described here allows this technique to be extended to the enlarging process, and when used properly will ensure a greater percentage of successful enlargements.

A phototube probe, shown in the photograph, is placed on the easel of the enlarger at a representative part of the picture, and the dial shown on the left of the indicator unit is set to a number corresponding to the photographic speed rating of the paper being used in the same way that a regular light meter is set for an appropriate film speed. The meter dial then indicates the optimum length exposure for that particular negative.

Circuit Details

As shown in Fig. 1, the circuit consists essentially of a Wheatstone bridge, one leg of which can be unbalanced by light shining on the phototube. The four resistors in the bridge circuit are: R, the plate resistance of the vacuum tube (including the cathode resistor R_c); and the two sections of the zero-adjusting potentiometer. A stabilized d-c voltage is applied across one diagonal of the bridge and a sensitive microammeter across the other diagonal indicates bridge balance and reads the amount of bridge unbalance when light shines on the phototube. The sensitivity of the phototube circuit can be varied by changing the d-c potential applied to the phototube by means of the paper-speed potentiometer.

The grid voltage of the pentode is determined by the current through the phototube. As more light shines on the phototube, causing its resistance to decrease, the grid potential of the amplifier tube is raised, causing its internal resistance to decrease. In this way the bridge is unbalanced and the amount of unbalance can be read on the microammeter. The meter can be calibrated directly in seconds exposure.

Application

The photometer has sufficient sensitivity for use with most amateur and professional enlargers when using exposures ranging from 10 to 80 seconds. If the enlarger has an adjustable diaphragm, it is convenient to place the probe unit at a representative part of the picture and then adjust the diaphragm so that the meter reads some favorite exposure which for the writer is 15 seconds because a synchronous timer for 15 seconds is used in the darkroom.

A few hints on construction will

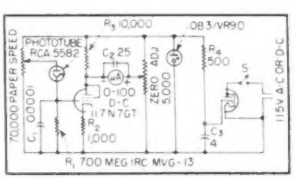

FIG. 1—Circuit diagram of the versatile light meter for determining exposure time in making photographic enlargements

be helpful. The photometer consists of two units; the meter unit and the photocell probe. The length of two-conductor shielded lead between these two units is not critical. If there is any hand capacitance effect while using the unit, the power plug should be reversed.

The unit requires a warm-up period of approximately 5 minutes during which time the zero adjustment will drift slightly. All of the components are standard radio parts with the exception of R_1 which has a resistance of 700 megohms. It should be borne in mind that the sensitivity of the photometer is directly proportional to this resistance; but since it is not necessary to use this unit at full sensitivity under normal conditions, a smaller resistance value could be used.

Meter Calibration

The photometer is calibrated by trial and error by making test exposures. It is best to let this calibration grow up over a period of time as the photometer is used. However, the following procedure is suggested as an aid in getting started.

Take a normal negative and determine the exposure required for a good enlargement. Any degree of enlargement can be used because the reading on the photometer is entirely independent of the degree of enlargement.

After making a good enlargement, place the probe unit of the photometer on the easel and with the paper-speed dial at some con-

LIGHT METER

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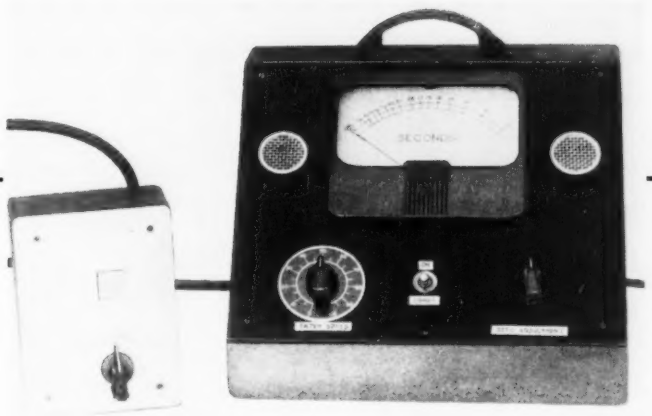

Exposure-indicating meter may be calibrated directly in seconds, or used in conjunction with a calibration curve. The probe unit is shown at left

venient setting. Then, with the window in the probe unit closed, set the meter on zero. Now open the window on the probe unit and read the meter. If the meter goes off scale, decrease the setting of the paper-speed dial until the exposure time known to be correct is indicated. If the meter does not read far enough up scale, increase the paper-speed dial setting. This paper-speed dial setting will now correspond to the kind of enlarging paper you are using and the meter reading will correspond to the number of seconds you used in making the enlargement.

The meter scale can be marked directly in seconds as shown in the photograph, or a calibration curve can be made. By using several negatives ranging from light to dark but using the same paper and leaving the same setting on the paper-speed dial, several exposure readings can be spotted. Note that this calibration now holds only for the paper-speed dial setting selected but that the meter calibration in seconds is good for all papers after the proper paper-speed dial setting for each has been determined.

With regard to the calibration of the paper-speed dial, it would be quite laborious to calibrate it for all papers commercially available but, since the average amateur photographer has a few favorites regularly used, its calibration is something which grows up over a period of time.

To give a general idea of the way in which paper speeds vary, the following experimental information is presented. For Brovira paper, of contrast numbers 1, 2, 3 and 4, typical exposure times are 12, 16, 20 and 40 seconds respectively; and for Cykora paper of the same contrast ratings, the exposure times are 28, 32, 36 and 56 seconds.

Mechanical Arrangement

The mechanical arrangement of parts is not critical except that leakage resistance in the circuit containing the phototube and R_1 should be kept to a minimum to get the maximum sensitivity which the exceedingly high resistance of R_1 can provide. For convenience in operation the photocell is housed in a small box so that it can be moved around on the easel under the enlarger while the meter unit is placed where it will be out of the way.

The photocell unit requires a small window which can be opened and closed by means of a knob. This opening should be $\frac{3}{8}$ inch by 1 inch, and the phototube should be mounted immediately under the window so that the light can shine through the window onto its cathode. The probe unit should be made as thin as possible so that the picture on the top of it will not be too much out of focus. The one shown in the photograph is $1\frac{1}{4}$ inches deep and has a panel measuring $3\frac{1}{2}$ by $4\frac{1}{2}$ inches. The panel is aluminum and the box is made of $\frac{1}{4}$-inch plywood. Small circles of felt were glued on the bottom for feet. The panel should be painted flat white on the outside and the box should be painted flat black inside and out. A small panel bearing is used to control the opening and closing of the window.

Care should be exercised not to open the window in bright light when the unit is turned on or the microammeter might be damaged. The unit should be used in such a way that the safe-light in the darkroom does not shine directly into the opening when a reading is being taken under the easel because the photocell will respond slightly to the light from the safe-light, thus giving an erroneous reading.

The sensitivity of the photometer is 7×10^{-3} foot-candles or 2.11×10^{-5} lumens.

POLYCATHODE GLOW TUBE for Counters and Calculators

New type cold-cathode discharge tube can be used as a digital counter and calculator, providing storage, carry to a succeeding stage, and self-indication. Capable of operating at a maximum speed of 100,000 pps, the tube can also be adapted to decade circuits with counting rates of better than 16,000 cps

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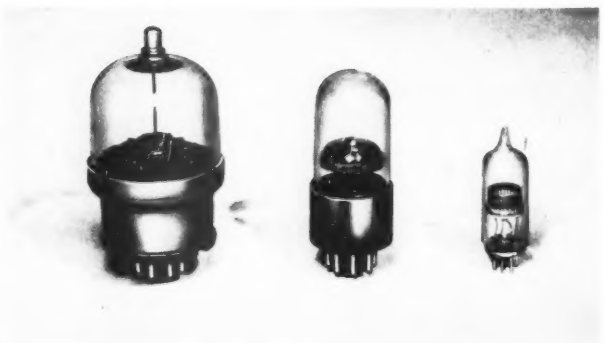


FIG. 1—Experimental polycathode tubes in three stages of development. Center tube has total of 75 cathode fingers. Others are decade types

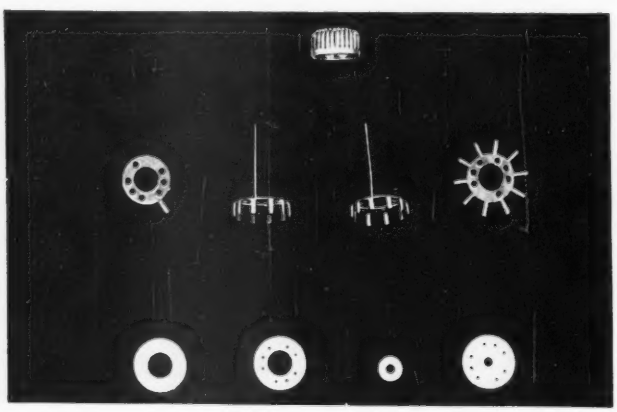
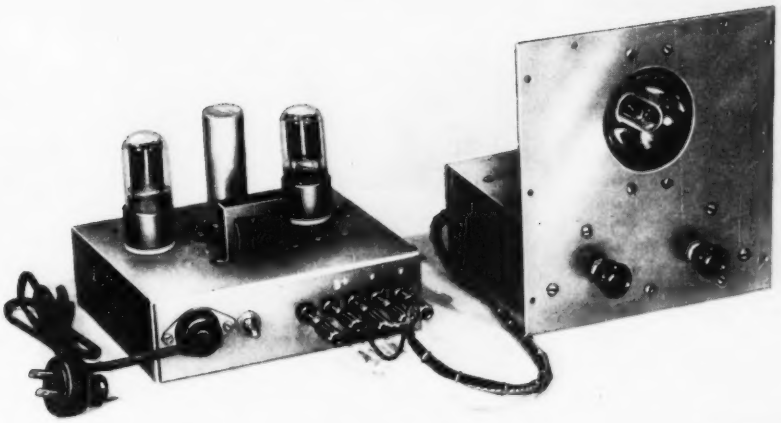


FIG. 2—Decade tube before assembly. Anode at top, two of the formed cathode-ring elements at center and preformed Carry at left. Ring at right not yet bent. Ceramic insulators below

BECAUSE of the rapidly growing interest in electronic counting and calculating devices there have been a number of electron-tube developments aimed at simplifying the circuitry involved between putting in the problem and reading out the result. The new tubes have generally been high-vacuum types, designed for operation in megacycle frequency ranges.

Not all calculating and counting applications are in the elegant scientific category, however, and there is a large field in which slower kilocycle-range rates of operation are permissible. In this range, devices such as thyratrons and neon diodes depending on ionization have their place in the calculator field but have been used mostly for switching purposes.

Standard thyratron types are available with only single sets of elements, so the tube complement becomes too great and power requirements too high for economical use. There is also an inherited distrust of the vagaries of ionization conduction devices. With the better understanding now being achieved of how to obtain stability in glow discharge tubes this distrust is being allayed. Furthermore, the major objections of high power consumption and too many tubes (which have handicapped the application of glow tubes in medium-frequency applications) have been minimized with development of the



Calibrator for between-lens shutters with speeds from 1 400 to 1 sec. In practice, the visual counter is turned on and the number of glow points on the negative is counted

tube to be described in this article.

The Remtron tube now in the experimental stage of development, is based on the original Mnemotron conception. Three typical examples of a series of steps in its development are illustrated in Fig. 1, from the large 2.5-inch diameter size with handmade elements at the left to the miniature size with machine-made elements at the right.

Structure and Operating Principle

Structurally, the new tube comprises four sets of concentric elements—a common concentrically located anode and three separate castellated cathode rings. The anode has the shape of a basket, with 30 narrow slots on its periphery. Mounted on the same axis as the anode are the three cathode discs formed with electrode fingers bent up around the periphery of each of the rings. Two of the cathode electrodes are designated the Index ring and Transfer ring, each having ten small electrode fingers symmetrically spaced on the periphery of the discs. The third cathode element, the Transfer-1 ring (Transfer minus 1 ring) is of similar shape but has one electrode finger less than the Index or Transfer ring. The tenth cathode finger, designated the Carry, is mounted separately. The elements are separated by insulating ceramic washers, illustrated in Fig. 2.

All the concentrically mounted electrodes are arranged in such a way that the electrode fingers of the separate castellated cathode rings are sequentially interspersed around the anode so as to align with the segments of the slotted common anode. The maximum diameter of the anode is 0.5 inch and the spacing between anode and cathode fingers is 0.020 inch. The gap between neighboring cathode fingers is about 0.025 inch. The assembly is mounted in a miniature-size envelope and filled with neon gas.

With proper voltage applied between anode and a cathode ring, a glow-discharge appears at one of the cathode fingers. Voltage pulses applied sequentially to the cathode rings through proper circuit arrangement then advance the glow-discharge from one cathode finger to the next, each impulse moving the glow-discharge by one finger. In the typical construction, each cathode disc has ten electrode fingers, the Carry being electrically connected with the Transfer-1. Usually, the anode is connected through a limiting resistor to a positive d-c supply of approximately 250 volts. The Index, Transfer, and Transfer-1 with Carry are directly connected to plates of three driver or buffer tubes. The potential difference between anode and cathodes established at the start of operation is such that breakdown will occur between only one of the cathode elements and the anode when a potential in excess of the breakdown voltage is applied.

Ordinarily it would not be possible to predict which cathode finger of this cathode ring would glow at the start; any one of the cathode fingers might accept the discharge were it not for a new feature. The single discharge is explained by the fact that as soon as one discharge is established at a cathode finger, its discharge current (passing through the series load resistor) causes a drop in the anode-to-cathode potential. The resultant lower potential is inadequate to initiate a second discharge at any other point on this cathode ring. It is this unique discharge feature which is the basis of the operation of the tube.

If the potential between anode and the cathode ring carrying the glow-discharge is again reduced below the value of extinguishing voltage, the glow will be extinguished. However, because of the residual ionization around this electrode finger the formation of another dis-

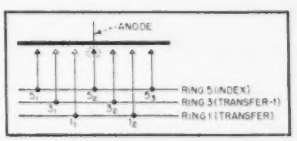


FIG. 3—Three-ring cathode insures sense of discharge progression

charge at a neighboring cathode finger (located on a different cathode ring) will be facilitated. De-energizing the first cathode ring and immediately energizing the second cathode ring thus results in a physical transfer of the discharge to the neighboring cathode finger.

The reason that the discharge will transfer only to the adjacent discharge point instead of arbitrarily to some remote point of the same multiple cathode is that the presence of ions in the region surrounding the discharge, persisting even after exciting voltage for the discharge has been removed, sets up preferential conditions for the re-establishment of a discharge in the immediate neighborhood of the region in which a discharge has just terminated. Thus, simultaneously making the potential of either of the two other cathode rings more negative with respect to the anode, while making the potential of the ring previously carrying the glow less negative with respect to the anode, will result in the formation of a new glow on the one electrode finger of the second ring closest to the previous glow. The same action can be repeated, and the discharge advanced one more finger, by continuing the process. In other words, successively decreasing and increasing the negative potential to anode of the three castellated cathode rings by properly applied pulses will advance the glow-discharge from one finger to the next. The glow-discharge can thus be moved clockwise or counter-clockwise, depending upon the external circuit arrangement.

Three cathode rings are employed rather than two for maintaining

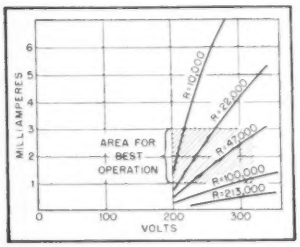


FIG. 4—Tube characteristics, showing most favorable voltage, current and resistor values

Decade direct-reading counter of four stages counting up to 10,000

sense of rotation. This effect is explained by reference to Fig. 3. If the glow is on finger 5_2 of a tube having only two rings, (for example, rings 5 and 3), the glow could move by random choice either to electrode 3_1 or to the electrode situated to the left of 5_2, that is to 3_2. Consequently, with only two rings, sense of rotation of the glow would be indeterminate, while with three cathode rings and appropriate external circuitry definite sense of rotation is predetermined.

The separate cathode element, the Carry, is connected to the Transfer-1 through a small resistance which ordinarily will not affect the operation of the tube. This Carry electrode is provided to supply an output marker pulse signifying a complete revolution of the glow. The Carry electrode is situated where a tenth finger of ring 3 would be located and its glow current will be nearly the same as that of the electrode elements on ring 3. The voltage drop across the resistor between the Carry electrode and ring 3 gives an output pulse every time the glow reaches this particular cathode finger. This pulse can be used to trigger a second similar stage once during each complete revolution of the glow-discharge in the first tube, this second stage being driven at either 1/30th or 1/10th the rate of the first stage, depending upon the type of circuit used.

Electrical Characteristics

Individual tubes show somewhat different operating characteristics. The maximum speed of operation is greatly influenced by gas pressure, type of gas used in the tube, size of elements, material used for contruction of cathode and anode elements, and especially by the surface condition of the electrodes. It has been found that extreme cleanliness in the construction of these tubes is essential, although controlled contamination may be desirable in some respects. Most consistent results have been obtained with pure neon gas at a pressure of approximately 13 cm in tubes made to date.

The power consumption of the new tube is small because only one cathode finger is glowing at a time. The tube can be driven easily by a single triode similar to the type 6J5.

It is operated in "normal" or "abnormal" glow condition only, never arcing.[2] To form a glow-discharge between anode and any one of the cathode rings the potential difference between the two elements must exceed the breakdown voltage of the gas, the glow being extinguished when the potential difference drops below the typical extinguishing voltage.

The operating current is not critical, but it has been found that best operation is obtained with currents of 1 to 3 ma as illustrated in Fig. 4. Discharge currents of more than 3 ma cause irregular advancement of the glow. Discharge currents of less than 1 ma generally are not sufficient to ionize the gas properly for continuous operation. This effect will be indicated by the tendency of the glow to skip back to the starting electrode after having advanced one or more positions from it. For typical operation the discharge current should be around 1.8 ma.

The shortest point-to-point transfer time at which the experimental tubes have operated, advancing the glow from one cathode finger to the next, is approximately 10 microseconds, corresponding to a maximum speed of 100,000 impulses per second. Continuous reliable operation of sample tubes has been accomplished with point-to-point transfer frequencies up to 50,000 per second. Wired for decade operation (utilizing three cathode fingers per input pulse) this represents a counting rate of more than 16,000 cps, or in mechanical terms, 1,600 revolutions per second of the glow around the anode. Experimental tubes with as many as 25 fingers on each cathode ring have been constructed and operated.

Single-Step Circuit

A simple circuit that illustrates the application of the tube is shown in Fig. 5. In this circuit arrangement the speed with which the discharge in the tube can be advanced from one cathode finger to the neighboring one may be varied over a wide frequency range. The single-step circuit utilizes three trigger stages and three buffer amplifiers. Negative input pulses are required to drive the circuit. The grid of each buffer amplifier is d-c connected to the plate of its respective trigger stage. The plate of each of the buffer stages is directly connected to one of the glow-tube cathode rings. The glow-tube anode receives its d-c potential through a variable limiting resistor from the positive supply of 250 volts.

Decade Circuit

A reset switch is provided for setting each of the trigger stages at the start of operation. Momentarily opening the reset switch will apply a positive voltage to the grids of V_{1B}, V_{2A}, and V_{3A}, thereby causing these half sections to conduct. The high positive potential on the grid of V_{1B} caused by the cutoff condition of V_{1A} will result in a low plate potential and large current through V_{1B}, thereby applying low potential on Transfer-1 and Carry. A visible discharge will form on the Carry or on one of the cathode fingers of Transfer-1. The grids of V_{1A} and V_{3B} are both d-c connected to the conducting sides of their trigger stages, resulting in reduced grid potentials on V_{2A} and V_{2B}. No discharge glow can form on Transfer or Index since both of their buffer stages are close to cutoff, resulting in high positive potentials on these cathode rings.

The reset switch also functions as a zero-setting device giving the glow discharge a definite position before applying impulses. In order to fix the starting location of the discharge on the Carry, the voltage between Carry and anode is made higher than any other by returning the Carry to ground potential through the reset switch.

Figure 6 shows a complete action cycle of all trigger stages and will help in explaining the stepping function. The shaded portion of each circle indicates the conducting side of the trigger stages. Starting at time t_1, there is a large potential difference between Transfer-1 (which includes the Carry) and the anode of the buffer stage connected to V_{1A}, while low potential differences exist between Transfer and Index and their respective buffer stages. Consequently, a glow will be formed only on a finger of Transfer-1 or on the Carry. A negative impulse through the common input line at time t_2 will cause section V_{1A} and V_{2B} to conduct. Tube V_3 will be unaffected by the pulse. The change in the conducting cycle of V_1 and V_2 will result in advancement of the

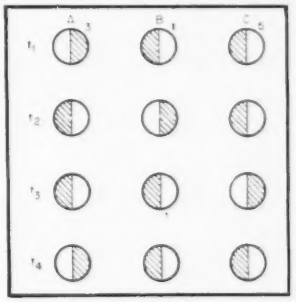


FIG. 6—Action cycle of trigger stages of Fig. 5 (see text)

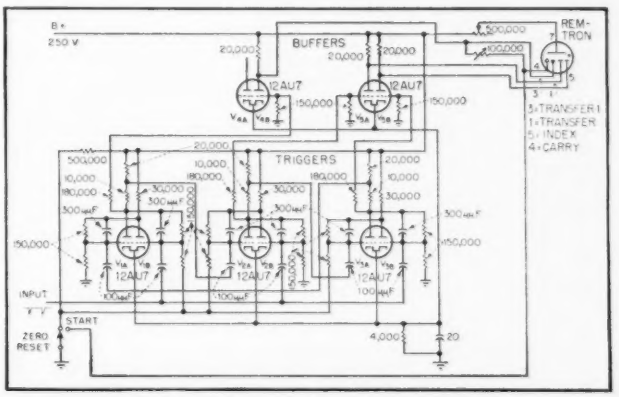


FIG. 5—A single-step discharge tube counting circuit

glow from the finger on Transfer-1 to a neighboring cathode finger on Transfer.

The following negative impulse at time t_1 will alter the conducting cycle of V_2 and V_3 and advance the glow by one more step, from the Transfer to the Index. Another negative impulse at time t_1 will move the glow to a cathode finger again located on Transfer-1.

Decade Circuit

A decade type of circuit requiring 10 negative input pulses for each complete revolution of the discharge in the tube is given in Fig. 7. The wave shapes at the various cathode rings are shown in Fig. 8.

Tubes V_1 and V_2 are used in flip-flop circuits and V_3 is a trigger stage. The output of each of these flip-flops and the trigger are fed through buffer stages to the cathode rings. At the start of the operation at time t_0 one cathode finger on the Index glows. A negative impulse at time t_1 will trigger V_3 and at the same time initiate the flip-flop cycle in V_1. The glow will move from Index to Transfer-1. After approximately 30 microseconds V_1 will return to its normal condition, thereby applying a negative pulse to flip-flop stage V_2, initiating its conducting cycle and causing another transfer of the glow from Transfer-1 to Transfer. After an additional 30 microseconds, this tube will return to its normal condition and the output from the plate of V_{1a} will trigger V_{3a}, bringing the stage back to its original condition. This will result in a further step of the glow to a finger located on the Index. Therefore, a single input pulse to the common input line of the circuit will advance the discharge by three electrodes; that is, from one cathode finger on the Index to the next finger on the same ring. Consequently, a series of ten input pulses will result in one complete revolution of the glow.

Also provided in the circuit is a clipper stage V_3 which receives its input through a transformer from the Carry. The output of this stage can be used to trigger the next decade unit.

The circuit for resetting the decade counter is of different design from the one outlined for the single-step unit. In a decade unit the glow is reset to the one cathode finger of the Index closest to the Carry. This is accomplished by the following procedure. During the inactive period of the circuit, the glow discharge will rest on one finger of the Index. Closing the reset switch will place the full negative potential of −105 volts on the Carry. This large negative potential will cause a glow discharge on the Carry electrode and, because of the increased voltage drop across the plate resistance, will extinguish the glow on the Index. Opening the reset switch will re-establish the potential difference between Index and anode. Since the region surrounding the Carry electrode has just been ionized, the glow will show preference to the one cathode finger of the Index situated nearest the Carry.

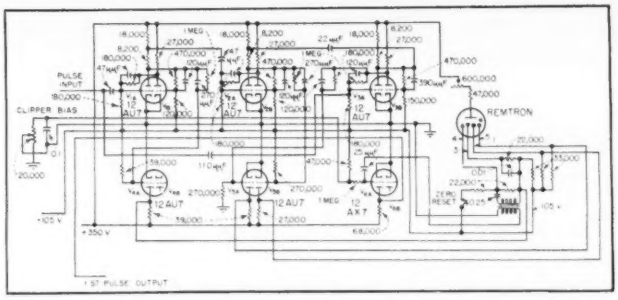


FIG. 7—Decade-type discharge tube counting circuit. A cascade form of this circuit is used to make a four-stage counter illustrated elsewhere

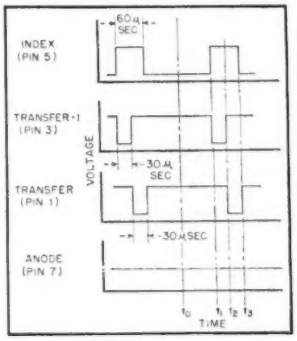


FIG. 8—Wave shapes encountered in circuit of Fig. 7

Practical Applications

Several novel instruments have been designed employing the new tube. Illustrated is a simple shutter-speed indicator, capable of accurately timing camera shutter speeds from 1/400 sec to 1 sec. The circuitry in this instrument consists of a variable-frequency phase-shift oscillator, feeding a network which in turn provides voltages of proper amplitudes and phases to the driver stages. In use, the operating tube is simply photographed and the glow points counted on the developed negative.

Also illustrated is a four-stage decade counter that can count and register up to 10,000 input pulses. The position of the glow discharge inside each tube indicates the digit stored. The electrical circuit of this unit is similar to the decade type described.

Acknowledgement

Acknowledgement is made to N. B. Wales, Jr. for his cooperation in the development of his invention; to H. J. Reich and H. L. Schultz of Yale University and J. R. Dunning of Columbia University for suggestions on tube design and processing, and to M. P. Wilder, chief engineer of the Laboratory tube department, for the detailed design and production of the experimental tubes. Acknowledgement for contributions to circuit development is made to L. P. Crosman, W. H. Henrich and P. J. Reuter of this Laboratory, and to H. T. Lyman and J. E. Cohen, former staff members.

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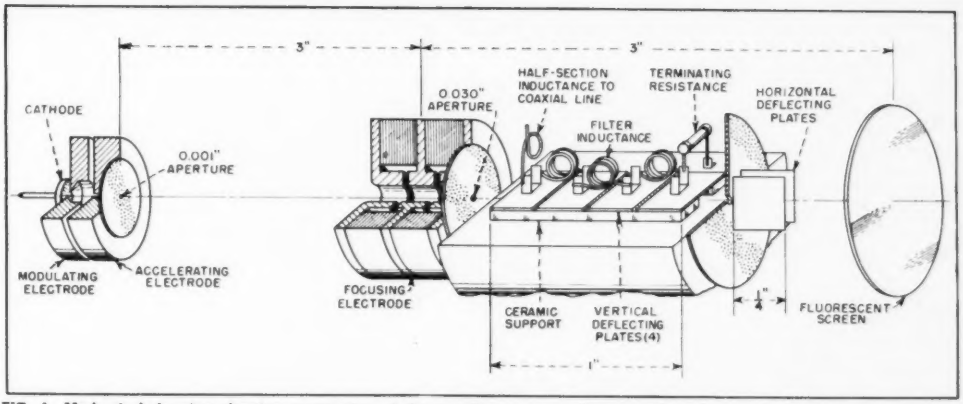

FIG. 1—Mechanical drawing showing construction of the traveling-wave oscilloscope tube. Structural elements are not shown

Traveling-Wave Oscilloscope

Experimental 1,000-volt tube, developed especially for examination of short recurrent pulses, has almost flat response from 0 to 500 mc. Input impedance is 75 ohms. A 0.37-volt peak-to-peak signal gives a pattern 10 trace widths high, for viewing through 60-power microscope

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VERY HIGH-SPEED oscillographs and oscilloscopes have been produced in the past.[1-4] The oscillographs in which a high-voltage electron beam falls directly on a photographic plate are admirably suited for recording single traces. Because such oscillographs are expensive, high-voltage, continuously-pumped devices they are not well suited for the general uses to which laboratory oscilloscopes are put at lower frequencies.

Hollmann's sealed off tube was used for visual observation of frequencies to around 3,000 mc. It had a deflection sensitivity, including the effect of optical magnification, of about 0.5 millimeter per volt. This would seem to call for signals of around 20 volts peak-to-peak for satisfactory observation. As amplifiers are not available for the bandwidths attained, this lack of sensitivity limits the use of the tube to rather high-level signals.

Lee's oscillograph suffered from a similar limitation; the deflection sensitivity was 0.001 millimeter per volt and the trace diameter 0.01 millimeter, and thus 100 volts were required for a deflection 10 times the trace width.

This paper describes an experimental 1,000-volt oscilloscope tube with an almost flat frequency response from 0 to over 500 mc. The signal input impedance is 75 ohms. Thus, the signal can be conveyed to the oscilloscope by means of standard 75-ohm flexible coaxial cable. A voltage of approximately 0.037 volt deflects the spot one trace width, so that 0.37 volt peak-to-peak gives a pattern about 10 trace-widths high. A sinusoidal signal of 0.37 volt peak-to-peak into 75 ohms represents a power of 2.3 milliwatts. Thus, an input of a few milliwatts gives an adequate response, and the oscilloscope can be used for most purposes without an amplifier. The horizontal deflection sensitivity is about 0.23 volt per mil.

The oscilloscope is intended for use as a general laboratory aid, especially in the examination of short recurrent pulses, much as oscilloscopes are used at lower frequencies. It is not suitable for the photography of single traces.

The performance of the oscillo-

scope is achieved through two means—the use of optical magnification of the pattern, and the use of a traveling-wave deflection system in order to provide good vertical deflection sensitivity without bandwidth limitation because of transit time.

The advantage of optical magnification of the image is easily made apparent. In the present tube the

Traveling-wave oscilloscope tube, shown in foreground, is viewed through the 60-power microscope mounted on the side of the housing box for the tube

spot is about 1 mil in diameter and a magnification of 60 diameters is used. The electron-optics could be altered to give 60 times the deflection for a given signal. This would result in a spot 60 mils in diameter and in a decrease in brightness by a factor of 1/3,600. The pattern would be almost or quite invisible. As it is, a microscope objective of numerical aperture 0.12 is used. This gathers about 400 times as much light as the pupil of the eye would at a viewing distance of 10 inches. Thus, neglecting light loss in the microscope, the brightness of the magnified pattern is about a tenth that of the pattern seen directly. An equivalent expansion of the deflection by electron-optical means would result in a pattern only about 1/400 as bright as that attained.

The use of four deflecting plates in a traveling-wave circuit rather than one plate makes possible either a gain in bandwidth by a factor of four for a given deflection sensitivity, or four times the deflection (a gain of 12 db) for a given bandwidth.

A detailed drawing of the oscilloscope tube would be complex and confusing, so the important elements only have been shown in Fig. 1 to give an idea of the construction of the tube. Most of the elements are machined of copper or monel.

All the electrodes shown in the sketch except the cathode, the modulating electrode, the focusing electrode, the vertical deflecting plates and one of the horizontal deflecting plates are supported mechanically and held electrically at anode potential by structural elements which are not shown. Electrons from the flat indirectly-heated cathode are focused on a small aperture (0.8 to 1.0 mil in diameter) in a thin copper disk by means of modulating and accelerating electrodes. The modulating electrode has a 30-mil aperture very close to the cathode. The disk with the 1-mil aperture and most of the rest of the structure are at anode potential, that is, 1,000 volts positive with respect to the cathode.

Three inches beyond the 1-mil aperture there is a symmetrical lens consisting of two outer apertured electrodes at anode potential, and a central focusing electrode held about 500 volts positive with respect to the cathode. A 30-mil diameter aperture in a disk just beyond the lens limits the diameter of the beam which enters the deflecting region. The lens images the 1-mil aperture on a fluorescent screen 3 inches beyond the center of the lens. The fluorescent material is deposited on a microscope cover glass. The screen can be viewed through an optically ground window sealed into the end of the envelope.

Deflection Systems

The deflection systems are one-sided. This is tolerable because of the very small angular deflections used. The horizontal system consists of two small plates, which are spaced 40 mils apart and are 0.25 inch square. The vertical system consists of four plates, each about 0.25 inch long. These plates are supported by ceramic strips 40 mils above a plane surface held at anode potential. The electron stream travels between this plane surface and the plates. The plates form the capacitive elements of a low-pass filter.

The assumed circuit of the filter is as shown in Fig. 2. The capacitances C are the capacitances of the individual deflecting plates to the opposed plane surface. The inductances L are small, self-supporting 3-turn coils. The inductance $L/2$ in series with the 75-ohm terminating resistance is merely the inductance of the resistor and its support. The half-section inductance in series with the coaxial input lead is a one-turn self-supporting coil.

The design values of the elements are $C = 3.2$ micromicrofarads and $L = 0.018$ microhenries.

The characteristic impedance K of the filter is

$$K = \sqrt{\frac{L}{C}}\sqrt{1 - \pi^2 f^2 LC} \qquad (1)$$

The element values have been chosen so as to make this 75 ohms at low frequencies.

The design cutoff frequency is 1,330 mc. At the higher frequencies the characteristic impedance of the filter departs substantially from the 75-ohm impedance of the coaxial input line and of the terminating resistance. This results in a standing wave at the input. The standing-wave ratio has been calculated for the design values of the elements and is plotted vs frequency in Fig. 3.

The phase shift β per section is given by $\beta = \cos^{-1}(1 - 2\pi^2 f^2 LC)$. At low frequencies this becomes approximately $\beta = 2\pi f\sqrt{LC}$ radians.

This low-frequency approximation corresponds to propagation of a wave along the filter with a constant velocity. As the tube was originally designed for 2,000-volt operation, the element values were chosen to make this velocity of propagation equal to the velocity of 2,000-volt electrons, that is, 0.089 times the speed of light.

Even if the filter had a constant phase velocity, there would be some reduction in sensitivity at high frequencies because of transit time past individual deflecting plates. This is aggravated by the fact that at the higher frequencies the phase shift β per section is not proportional to frequency. The reduction of response because of transit time has been calculated for the design values of the filter parameters and is shown in Fig. 3.

While the tube was originally intended for 2,000-volt operation and the filter was designed accordingly, it was found that the trace was bright enough at 1,000 volts, and the tube has been used chiefly at this voltage. The 1,000-volt curve of Fig. 3 shows that transit-time effects are not at all bad at 1,000 volts.

The actual standing wave has been measured up to 500 mc and has been found to be somewhat worse than indicated by Fig. 3; the standing-wave ratio rose gradually to about 3 db at 500 mc. This is probably because of inaccurate element values. The d-c capacitances departed a little from the design values. The coils used were not measured individually or in place; dimensions were based on measurements with a standing-wave machine.

The measured sensitivity for 1,000-volt operation fell less than 1 db from 0 to 500 mc.

Spot Size

The spot diameter has been variously estimated. One tube had a first aperture approximately 0.8 mil in diameter. With a horizontal sweep covering the width of the screen, a 0.028-volt peak-to-peak square wave gave at the center of the screen two bright traces just separated by a narrow dark line. This implies a spot width of 0.75 mil. Thus, it is felt that the figure of 0.037 volt per spot width, which was given earlier, is reasonably conservative.

With the 60-power microscope used, the field corresponds to a total deflection of about $\pm$ 1/16 of an inch. The allowable vertical deflection appears to be about half of this, partly because of interception of electrons by the plates.

So far the tube has been used with a sinusoidal sweep in a circuit substantially as shown in Fig. 4. An oscillator drives a circuit under test, such as a pulser, and the output of this circuit is fed to the coaxial input of the vertical plates by means of 75-ohm coaxial cable. The oscillator also drives the horizontal plate by means of a resonant circuit. The phase of the voltages can be adjusted by using cables of different lengths between the circuit and the tube, and a fine adjustment is obtained by tuning the resonant horizontal-deflection circuit.

The photograph shows the tube,

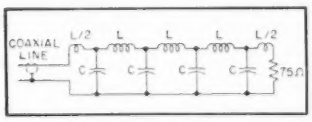

FIG. 2—Assumed circuit of the filter formed by the deflection systems

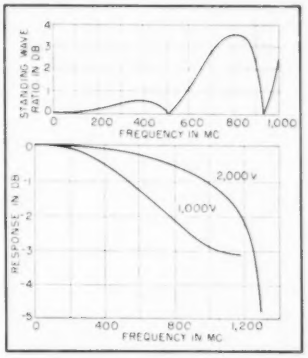

FIG. 3—Curves showing computed standing-wave ratio and computed transit time loss vs frequency. Measurements show close adherence to computed values

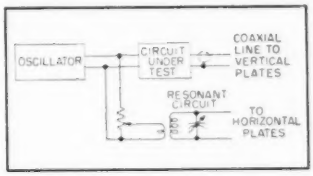

FIG. 4—Block diagram showing typical set-up using traveling-wave oscilloscope

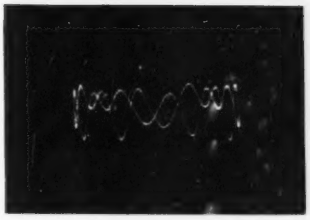

FIG. 5—Enlargement of photograph of screen. Horizontal signal is 40-mc sine wave, and vertical signal is the output of a harmonic producer with 320 mc predominating. Peak-to-peak deflection is approximately 0.03 inch

and a metal box containing the tube, with a 60-power microscope mounted for viewing the screen. The coaxial input at the lower left is that to the vertical plates, and that at the lower right goes to the resonant circuit across the horizontal plates. It is imperative that the tube be mounted in a magnetic shield.

Figure 5 shows an enlargement of a photograph of the pattern. The sweep was a 40-mc sine wave and the output of a harmonic generator giving predominantly 320 mc was applied to the vertical plates. The microscope objective was used as a lens. The exposure was $\frac{1}{2}$ second, with 1,000-volt operation.

The tube has proved very useful in its present form, but it is possible that even better results could be achieved through careful development work. Thus, it seems likely that the deflection sensitivity could be somewhat improved without loss of brightness. For instance, a higher cathode current density and a smaller aperture might be used, together with greater optical magnification.

The tube owes much of its success to good mechanical design and careful supervision of construction by F. H. Best of these Laboratories.

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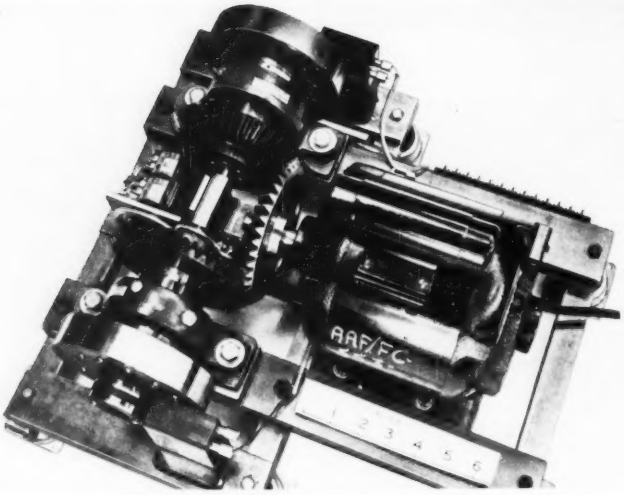

Test setup including two magnetic fluid clutches (adjacent to slip rings at top and bottom). Clutch rotors are driven by a-c motor through differential gear arrangement

MAGNETIC FLUID CLUTCH in

Report on experience obtained with various iron-disk rotor designs running in oil and powdered iron mixture that solidifies when magnetic field is applied. At natural frequencies below 30 cps such clutch units are highly useful in servomechanisms

THE POSSIBILITY of using the magnetic fluid clutch[1] in servomechanisms has led to a sufficiently thorough investigation to arrive at the following conclusions concerning its performance and application:

(1) Maximum natural frequencies of servomechanisms incorporating magnetic fluid clutches with disk design and dimensions as in Fig. 1 are limited (because of transient time lags) to about 30 cycles per second.

(2) Maximum transmitted horsepower with rotor and stator locked is limited only by the size and strength of structural materials used.

(3) Maximum transmitted torque with slip between rotor and stator depends primarily on the ability of the clutch to dissipate large amounts of heat. In this condition, with the rotor operating against a spring load, the heat generated is a function of rpm and applied torque. About 250 watts can be safely dissipated in a single-disk 3-inch clutch operating at ambient room temperature and having no cooling vanes.

(4) All bearings must be adequately sealed against the magnetic fluid. The single-disk 3-inch clutch design of Fig. 1 has been in operation for over 300 hours with negligible loss of fluid, with the motor shaft horizontal.

(5) For a 3-inch single-disk clutch, speeds under 3,000 rpm give no trouble from a centrifugal packing of iron on the rotor periphery.

(6) A high nickel steel such as Allegheny 4750 is recommended for stator and rotor construction to eliminate adverse effects of hysteresis in these components.

(7) An increase in torque using the same excitation current can be obtained by using a rotor disk with concentric holes near the periphery.

(8) Magnetic fluid clutches are not recommended for use on spring loads unless provisions for heat dissipation are made.

Time Lags

Four servo systems employing clutches as output components have been built and tested sufficiently to determine the natural frequency for each system. In each case, this frequency was found to be about 29 cycles per second. However, the restoring torque constant K measured at steady state and the inertia J of the system when converted to suitable units and substituted into the

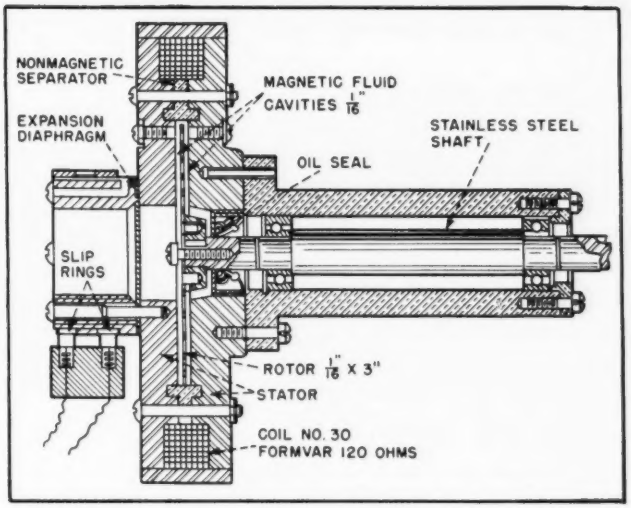

FIG. 1—Cross-section of single-disk magnetic fluid clutch. Rotor disk is bolted to end of shaft

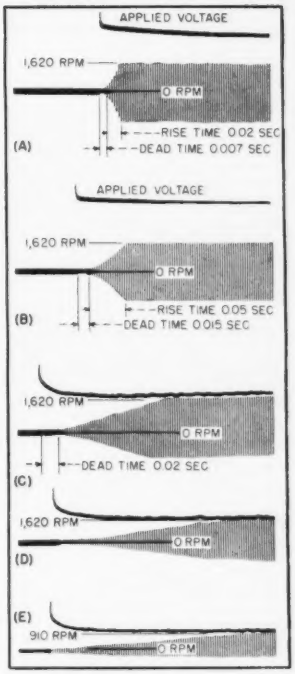

FIG. 2—Transient speed response oscillograms of magnetic fluid clutch, obtained from 400-cycle drag-cup tachometer coupled to clutch output shaft

Servo Applications

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equation $\omega_n = \sqrt{K/J}$ indicated a natural frequency ω_n much higher than that obtained.

It was at first believed that the inertia of the system could not be correctly determined by conventional methods. Since the two rotors were running in a mixture of iron and oil, it seemed possible that the inertia of the system might be changed by the accumulation of packed iron on the rotor, and that the reduced frequency response was caused by the greater inertia. The system inertia would have to change by a factor of ten, however, to account for the discrepancy. In no case could an increase in inertia of more than a few percent be traced to this cause.

The transient speed response of a magnetic clutch unit with a near saturated magnetic circuit is shown in Fig. 2A. The dead time of 0.007 second represents the smallest lag obtainable with this clutch. The rise time to 1,620 rpm of 0.02 second represents the maximum acceleration.

The remaining oscillograms in Fig. 2 show that the dead time is directly proportional to the exciting voltage. In Fig. 2E the applied torque is not sufficient to overcome the viscous drag, hence the rotor never reaches its maximum speed.

The only remaining parameter able to account for the frequency response obtained is the torque T. This was investigated by taking the equation of motion $J\omega' + F\omega = T$ and assuming J a constant as measured equal to 400 and F a constant equal to 6,000. From the oscillogram of Fig. 2D, ω' and ω were obtained for about 12 points along the

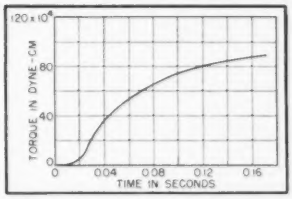

FIG. 3—Transient torque response of single-disk 3-inch clutch

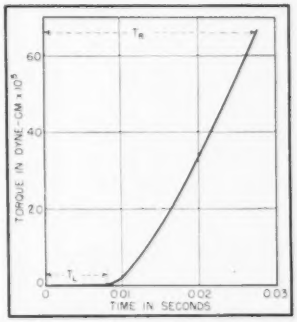

FIG. 4—Transient torque response of single-disk 3-inch clutch operating with maximum applied voltage

envelope and the sum $J\omega' + F\omega$ was plotted for each point. The resulting plot of torque obtained is shown in Fig. 3.

The equation $f_n = 1/(T_L + T_R)$ gives the highest stable fundamental frequency f_n obtainable[2] from a servo with the indicial response shown in Fig. 3. Here T_L is the dead time and T_R is the response time. For the particular input applied in this case, the frequency of oscillation would be about 8 cycles per second.

The torque response curve obtained with data from Fig. 2A is shown in Fig. 4. The applied current in this case was sufficient to exceed the saturation knee of the magnetic circuit, and therefore represents the condition of maximum torque. No response is indicated for 0.007 second, and maximum torque is reached in not less than 0.027 second. Using the criteria mentioned previously, the maximum frequency would be $f_n = 1/(0.007 + 0.027) = 30$ cycles per second. The value is an upper limit for this particular clutch design. This provides the most reasonable explanation of why a higher frequency response cannot be obtained with the given clutch dimensions.

Rotor Design

Several rotor configurations were considered. In all cases, however, thinking was guided by the desire to remove as much metal from the rotor as possible and still retain or increase the torque and maintain sufficient structural strength. Configurations of four disks which appeared most promising in this respect are shown in Fig. 5. Slotted disks were tried but discarded because of poor performance. The disk configuration of Fig. 5D was tried in an attempt to counteract the effects of centrifugal separation of iron and oil. Results of tests on the other three disks at two speeds are shown in Fig. 6. The curves indicate that for the same excitation current, rotors with holes give a torque higher than that obtained with the solid rotor. The weight of the solid rotor is about 50 percent higher than that of the lightest rotor. The reason for the increased torque has not been satisfactorily explained.

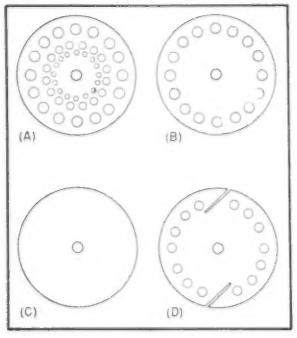

FIG. 5—Disk configurations used during experiments with 3-inch clutch

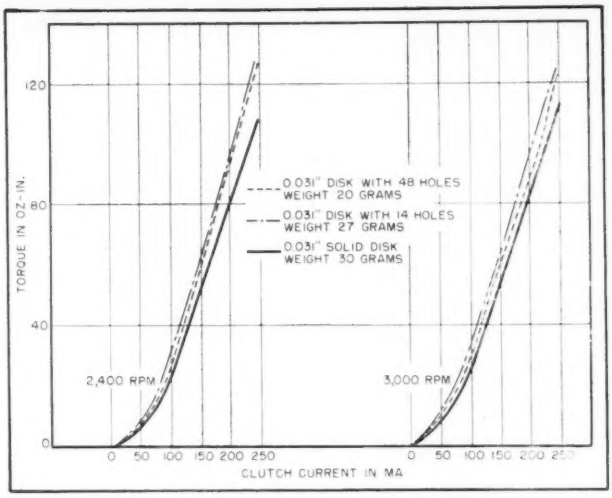

FIG. 6—Current-torque curves obtained with three different disk configurations for steady-state operation at two different speeds

To date, the maximum torque obtained from any of six clutches has been 1,100 ounce-inches at 700 ma. The limiting factor in this test was not the clutch, but the power supply furnishing the current. As yet, no clutch has been completely saturated.

Centrifugal Effects

In order to check the effects of centrifugal separation of iron and oil, a 3-inch clutch was run with rotor and stator at the same speed. No excitation was applied. The weight ratio of the iron-oil fluid was 6:1. The spacing between rotor and stator walls was 1/16 inch. Tests were made to determine how long the clutch could be run at 2,400 rpm without ill effects from packing of the powdered iron and subsequent binding of the rotor.

At first, the rotor and stator were run at zero relative speed for two minutes. Little effect was noted. Testing time was increased until the stator and rotor were run together for about 1 hour. At the end of this time, the torque required to stall the rotor with stator running at 2,400 rpm with no excitation was found to be very high, in the order of 1,200 ounce-inches. The result of this test is shown in Fig. 7.

It is interesting to note that although an increased drag is produced, it does return to normal in about 20 minutes. This was found to be the worst possible case. Adding excitation decreases this effect. It is improbable that any servo would run with stator and rotor locked for any length of time comparable to the test conditions, because the duty cycle for a servo application is generally only a few seconds.

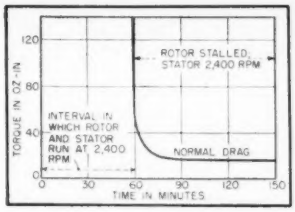

FIG. 7—Change in clutch drag due to centrifugal packing of iron powder

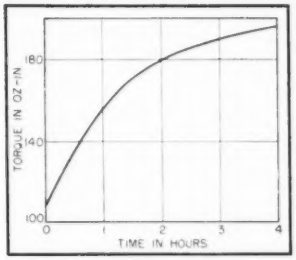

FIG. 8—Permanent effects of running rotor and stator at same speed for long periods of time. Speed was 2,400 rpm

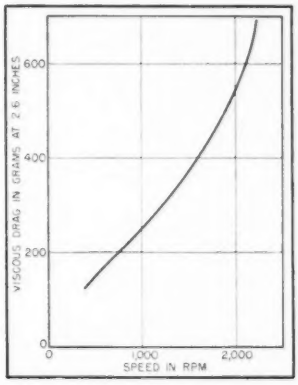

FIG. 9—Viscous drag for single-disk 3-inch clutch

An apparently permanent effect of centrifugal action is an increase in torque for the same excitation current when the stator and rotor are run at same speeds for long periods of time. After each period of running the rotor and stator together, the rotor was stalled and the drag permitted to return to normal before any torque measurements were taken with excitation applied. The results are shown in Fig. 8.

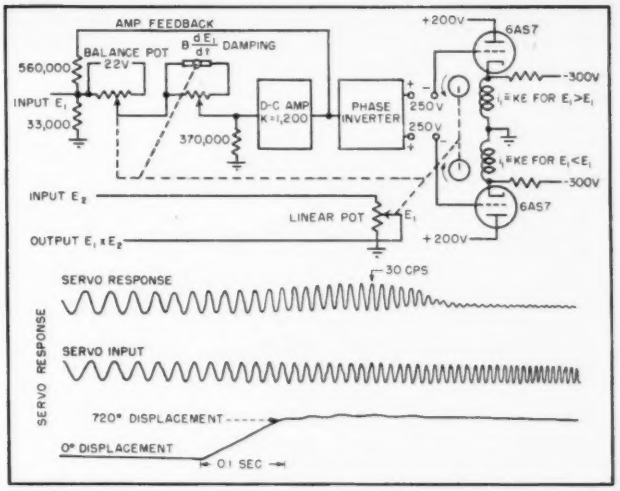

FIG. 10—Servo system used as multiplying device, with magnetic fluid clutch for fast response in multiplying two voltages. Responses of this servo to step input and variable sinusoidal input are shown below

The torque exerted on the rotor due to the viscosity of the magnetic fluid can be readily measured at various speeds. This effect was measured using a 3-inch single-disk clutch with a 14-hole rotor. The stator was driven from a variable-speed motor, and the stalled rotor torque was measured with a spring scale and lever arm fixed to the rotor. No excitation was applied to the clutch. The variation of torque with rpm is shown in Fig. 9. For the lower portion of this curve, the friction torque per unit output speed is about 5,600 dyne-cm per radian per second.

Residual Torque

If one considers a single clutch, then the ratio of residual torque to maximum torque for this particular size is approximately 6:1,000, or less than 1 percent. If the clutch is to be applied to a servo system, then in all probability two clutches running in opposition will be used. In such an application, the residual torques will cancel each other. The torque due to viscosity must still be considered, since as one clutch is excited, the other clutch rotor will change speed. This factor will cause the relative rotor-stator speed to possibly double.

The servo system shown in Fig. 10 is used as a multiplying device. In view of the lack of accurate low-torque potentiometers and the necessity of fast response in multiplying two voltages, it seemed the magnetic fluid clutch could be advantageously used in this application. The response of this servo to a step input and a variable sinusoidal input is also shown. The step input is sufficient to enable the clutch rotor to run at maximum speed before reaching balance.

It is important in using magnetic fluid clutches in servo applications that units be used which are as nearly identical as possible. For dissimilar clutches, the gain of the system would depend on which clutch is excited. The present accuracy is $\pm$ 0.1 percent, which is the accuracy of the potentiometer.

No detailed explanation of this servo is given here since the operation is fully explained in a previous paper[3]. The author acknowledges the assistance of Lyle Martin and Lewis Nelson.

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(2) "Dynamics of Automatic Controls", American Society of Mechanical Engineers, 1948.

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Measurement Method

The relationship between screen brightness and input voltage is approximated by a power law, with the exponent 2.2 for the 10BP4 and 2.5 for the 10FP4. The exponents indicate the transfer characteristic when the maximum brightness is also given

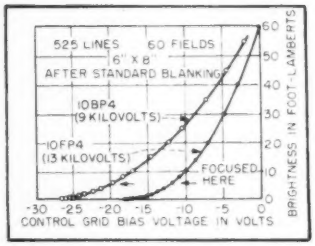

FIG. 1—Sample characteristics of the 10BP4 and 10FP4

IN CONSIDERING the picture tube as a circuit element in a television circuit, it is necessary to know how video signals are transmitted through the tube.

The only characteristic to be considered here is the one relating output amplitude (brightness) to input amplitude (voltage), sometimes called the transfer characteristic. Picture tubes have other important characteristics, chiefly frequency effects associated with spot size and contrast effects due to internal reflections of light, but these may safely be ignored in the method of measurement that follows.

Sample characteristics measured by this method are shown in Fig. 1. The things to note are the large range of brightness values, nearly 1,000 to 1 for the newer tube, and the good fit of the points to a smooth curve. This smoothness is inherent in the nature of the quantity actually measured, namely the logarithmic derivative of the brightness-voltage curve.

This quantity is immune to the small fluctuations, introduced by line voltage variations, that often interfere with direct measurement of brightness and voltage. Also, the process of integrating the logarithmic derivative into the brightness-voltage function is in itself a smoothing operation.

Circuit

The method of measuring the logarithmic derivative is shown in Fig. 2. The cathode of the picture tube is connected to an auxiliary circuit carrying an on-off d-c signal controlled by a mechanically operated switch. The amount of signal required on the cathode ranges from about 0.2 volt to about 2 volts.

The control grid of the picture tube is fed, through a suitable coupling capacitor, an all-white composite picture signal of standard

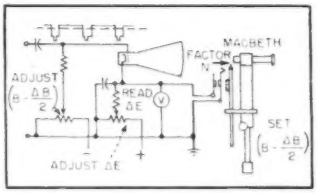

FIG. 2 — Circuit for measuring the logarithmic derivative

form and appropriate amplitude. The usual deflection signals are applied to produce a normal television raster on the screen. The brightness of this raster is controlled by adjustment of the bias on the control grid.

Incremental changes in screen brightness are made by the cathode signal, poled up so that the screen is brighter when the signal is off. The cathode signal is turned off, and the screen consequently brightened, by a switch at the Macbeth Illuminometer shown on the right in Fig. 2. This action coincides with the mechanical insertion of a light neutral filter into the optical path between the picture screen and the Illuminometer. Opposing factors thus operate on the brightness seen through the Illuminometer eyepiece —the cathode signal acting to increase it, the neutral filter acting simultaneously to decrease it. There is thus a particular value of cathode signal that yields a null result when the neutral filter is moved either into or out of the optical path. Finding that value of ΔE by successive trials constitutes the measurement.

There are two reasons for this particular arrangement: it saves recording time by having the value of ΔE appear on the voltmeter when the neutral filter is in its rest position out of the optical path, and it avoids the possibility of error in ΔE due to cathode current in the picture tube.

When this null condition exists, the various quantities appearing in Fig. 2 are related as shown in Fig. 3. The screen brightness takes on

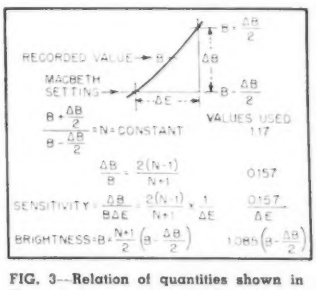

FIG. 3—Relation of quantities shown in Fig. 2 when proper cathode signal is found

for Picture Tubes

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FIG. 5—Measuring unit employs microscope cover glasses for the neutral filter

two values, $B + (\Delta B)/2$ when the neutral filter is in, $B - (\Delta B)/2$ when it is out, and these two values stand in the constant ratio N fixed by the filter.

What is seen through the Macbeth eye piece is always the lower value. Since neither ΔB nor ΔE is infinitesimal, the exact value of brightness at which their ratio represents the derivative is unknown. However, the overall accuracy of the measurement is not compromised if the arithmetic average B is taken in place of the exact value. The ratio $(\Delta B)/(B\Delta E)$ is then taken to be the logarithmic derivative, and is here called the sensitivity. A higher value of sensitivity requires a smaller value of

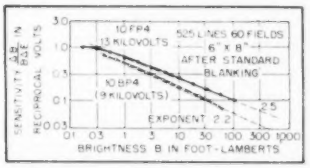

FIG. 4—Measured sensitivity curves are nearly straight lines

signal voltage to produce a given visibility of brightness change on the screen.

Sensitivity Curves

Measured sensitivity curves are shown in Fig. 4. The significant aspect is that they are nearly straight lines on this log-log plot. It follows that the derived relationship between brightness and voltage (Fig. 1) may be approximated by a power law, with the exponent 2.2 for the 10BP4 or 2.5 for the 10FP4. These exponents specify the characteristic of a picture tube concisely and adequately if the maximum usable brightness is also stated.

The slope of a log-log plot of sensitivity against brightness is related in simple fashion to the exponent of the corresponding power law. If the power law is $B = E^n$ and if we take the logarithmic derivative as a good approximation to the measured sensitivity:

$$S = \frac{\Delta B}{B\Delta E} = \frac{dB}{BdE} = nB^{1-1/n}$$

then: $\log S = \log n - 1\ n \log B$ and the slope of the log-log plot is $-1\ n$. The higher the exponent, the smaller the value of the slope. When the exponent is infinite the slope is zero, and in this limiting case the power law becomes an exponential law:

$$B = a^E$$

$$S = \frac{\Delta B}{B\Delta E} = \frac{dB}{BdE} = \ln a$$

and $\log S$ is independent of $\log B$.

The measured sensitivity curves are integrated by straightforward step-by-step summation of small voltage differences, working downward from the maximum brightness we decide to call usable. Taking the 10FP4 curve in Fig. 1 as an example, we start at 60 footlamberts and make the first step down to 40 footlamberts.

For an average of the sensitivity over this step, take its value at 50 footlamberts, the mid-point. That is, take $(\Delta B)/(B\Delta E)$ to be 0.134 per volt. The brightness step ΔB is minus 20 footlamberts, the average brightness B is 50 footlamberts, and the voltage step ΔE turns out to be -3.0 volts. So we plot the 40 footlambert point 3.0 volts away from the 60 footlambert point, in the negative direction.

The second step is down to 30 footlamberts. At the mid-point, 35 footlamberts, $(\Delta B)/(B\Delta E)$ is 0.156 per volt. For this 10 footlambert step, the second voltage step ΔE is -1.8 volts. The 30 footlambert point is plotted 4.8 volts away from the 60 footlambert point, in the negative direction; and so on down the curve.

Optical System

Figure 5 shows the measuring attachment mounted on a Macbeth Illuminometer. The lightshade has been moved out of position to show the neutral filter and its guides. This neutral filter is made of two clear microscope cover glasses, comprising four air-glass reflecting surfaces. Its measured visual density is 0.07 (transmission 85 percent, factor $N = 1.17$). The manually operated switch, not visible, closes when the neutral filter is half-way into the optical path as shown.

Harmonic Analyzer

Electromechanical instrument capable of analyzing or synthesizing any waveform which can be represented by a Fourier sine or cosine series in twenty terms or less. Data is presented on two recorders, in a form familiar to engineers, with an accuracy of 2 percent

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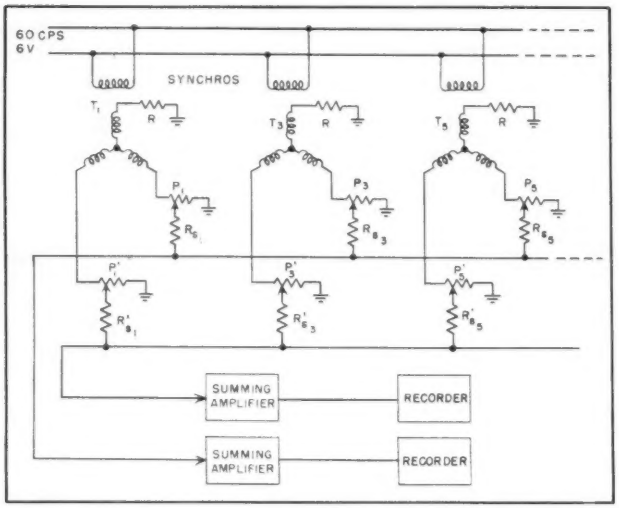


FIG. 1—Fundamental circuit shows how resistors are used to obtain two-phase output from three-phase synchro-transformers

IT IS COMMON PRACTICE to use the frequency-response method to compute the square-wave response of a network, or to judge the frequency response by examining the square-wave response. Frequency response or square-wave response can be computed by methods found in most engineering textbooks, but the computations are usually quite laborious and time consuming.

Harmonic analyzers capable of carrying out such computations have been in existence for quite some time, but most of these are purely mechanical and not very easy to handle. The analyzer-synthesizer described here is easy to operate and presents the results in a form familiar to engineers.

The instrument is provided with dials on which the amplitude and phase of twenty terms can be set. To synthesize, the amplitude and

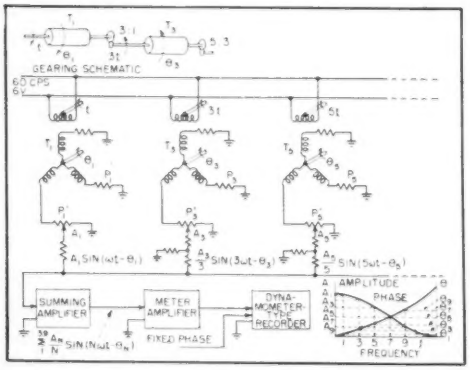


FIG. 2—Circuit arrangement used for synthesis of a square-wave response. The curve in the corner is a typical frequency response curve used for synthesis

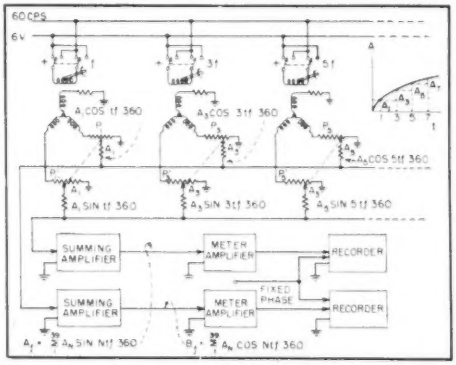
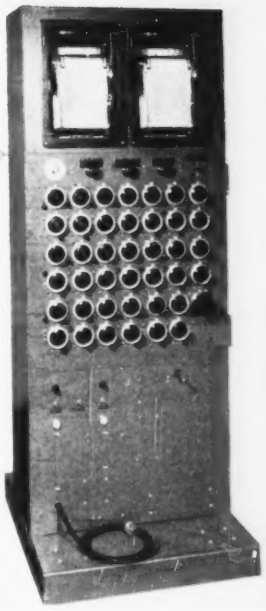


FIG. 3—Circuit arrangement for analysis of square-wave response. A square-wave response curve with regularly placed steps is shown in upper right-hand corner

and Synthesizer



Two dials for each term permit adjustment of phase and amplitude in the harmonic analyzer and synthesizer

phase response of the first twenty odd harmonics are set on the dials, and the response is obtained as a plotted curve on one dynamometer-type recorder. To analyze, the amplitudes of the steps of a stepped wave are set on the amplitude dials, and the frequency response is obtained as two plotted curves from two recorders. The two curves may give the frequency response in rectangular or polar coordinates.

Square-Wave Synthesis

A symmetrical square wave is represented by the series: $f(t) = \sin \omega t + \frac{1}{3} \sin 3\omega t + \frac{1}{5} \sin 5\omega t + \ldots + 1/n \sin n\omega t$.

In order to get the square-wave response of a network or amplifier, knowing its frequency response, we have only to add the vectors representing the response of the different odd harmonics, the amplitude of each harmonic being divided by the order of the harmonic. If this summation is carried out for all values of t corresponding to one-half cycle of the fundamental, the response to one-half square wave is obtained. If the frequency of the fundamental is low enough and is chosen such as to make the contribution of the last harmonic negligible, the response to the square wave will be the same as the response to a unit step.

Synchro-transformers are used in the instrument to generate trigonometric functions. Only three-phase synchros were available at the time the instrument was built, and it was necessary to use a resistor network to obtain voltages varying like the sine and cosine as a function of the angular displacement of the rotor. The fundamental circuit Fig. 1 shows the arrangement being used. The resistors R, P, and P' constitute a network giving two-phase output from the three-phase stator. Twenty such synchros are used, and they are geared in the ratio 1 to 3 to 5. . . .

The first synchro T_1 will therefore represent the fundamental frequency; by a special gearing arrangement its rotor makes one revolution while the rotor of synchro T_3 makes three. Then T_3 represents the third harmonic, T_5 the fifth, and so on.

A motor drive is provided which will drive the gear train from the highest harmonic. The sine output is taken from the potentiometers P' while the cosine output is taken from the potentiometers P. These potentiometers are combined in a dual pot and are set together to the amplitude of the respective harmonic.

The phase angle of each harmonic is set by turning the stator of the corresponding synchro.

The output voltages of the potentiometers are added in the summing resistors R_1 and R_1' respectively, and amplified in two feedback amplifiers. The amplifiers' output can be recorded on two recorders, the paper drums of which are geared to the synchros so that one $\frac{3}{4}$-in. division represents 20 degrees of the fundamental.

Figure 2 shows the circuit arrangement used for the synthesis of a square-wave response. In the lower right is shown a frequency response curve such as may be used for the synthesis. A schematic of

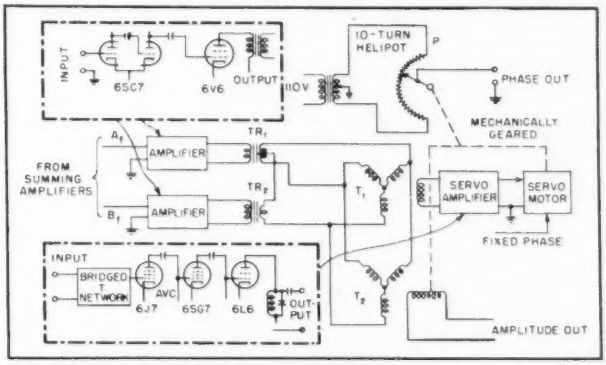


FIG. 4—Servo circuit which solves equations for amplitude and phase. The two outputs of the servo system, phase and amplitude, are amplified in the meter amplifiers and recorded

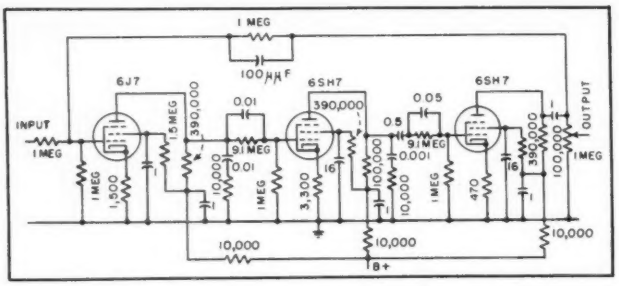


FIG. 5—Circuit diagram of summing amplifier with current feedback

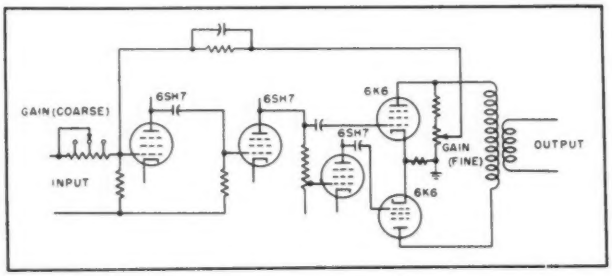


FIG. 6—Partial schematic of meter amplifier shown in Fig. 2 and 3

the gearing arrangement is shown on top. The amplitude values of the fundamental frequency and each odd harmonic up to the 39th are set on the P' potentiometers. The values of the phase lead or lag (+ or −) are set by turning the stators of the synchros. The summing resistors are made up of networks in which the contribution of each harmonic is divided by the order of that harmonic. The output voltage of the summing amplifier will then represent the square-wave response at one particular instant. The complete response will be obtained by turning the gear train until the rotor of the first synchro T_1 has completed one half revolution.

The output of the summing amplifier is fed to the meter amplifier which drives the dynamometer-type recorder. A fixed phase is supplied to the recorder from an a-c supply which will be described later.

Square-Wave Analysis

In the method used, the square-wave response is replaced by a stepped wave, the steps being placed at times t_1, $3t_1$, $5t_1$ . . . , the amplitude of the steps being A_1, A_3, A_5 . . . Provided the amplitude of any step after the 39th is small enough to be neglected, this method will give a continuous frequency response from zero frequency upward.

It can be shown that the contribution of a term of frequency f to the stepped wave is proportional to:

$$A_f/\theta = A_1/t_1 f\,360^\circ + A_3\ 3t_1 f 360^\circ + A_5 5t_1 f 360^\circ + \ldots .$$

This sum can be written in the form: $A_f = A \sin t_1 f\ 360^\circ + A_3 \sin 3t_1 f\ 360^\circ + A_5 \sin 5t_1 f\ 360^\circ + \ldots .$ $B_f = A \cos t_1 f\ 360^\circ + A_3 \cos 3t_1 f\ 360^\circ + A_5 \cos 5t_1 f\ 360^\circ \quad \ldots .$

Figure 3 shows the circuit arrangement used to obtain the summation. A square-wave response with regularly placed steps is shown in the upper right-hand corner. The first dual potentiometer P_1P_1' is set to A_1; the next one to A_3, and so on. A reversing switch on the single-phase windings of the synchros permits positive and negative values to be inserted. The outputs of all the sine components are summed in one summing amplifier, and the cosine components are summed in the other summing amplifier. The outputs of the two summing amplifiers give, therefore, the frequency response at some frequency f in rectangular coordinates. The two coefficients A_f and B_f can be recorded on the recorders, and a complete frequency response can be obtained by rotating the gear train until one-half cycle of the first rotor is completed.

The coefficients A_f and B_f are seldom used; it is customary to give a frequency response in the form of amplitude and phase. The amplitude and phase may be computed using the relations:

$$A_F = \sqrt{A_f^2 + B_f^2} \qquad \tan\theta = \frac{A_f}{B_f}$$

A servo system has been included in the instrument which solves these equations, and permits the amplitude and phase characteristics to be recorded directly. A block schematic of the servo is shown in Fig. 4.

The outputs of the summing amplifiers go to two identical amplifiers, the output transformers of which are Scott connected to give a three-phase output. The three-phase synchro T_1 is connected to the transformers as shown, and the voltage output of its single-phase rotor constitutes the input signal to the servo amplifier.

The servo motor is geared to the synchro and also to a Helipot P. The position of the brush on the Helipot will indicate the magnitude of the phase angle. A second synchro T_2 with its rotor perpendicular to the rotor of T_1 is also geared to the servo motor. Since the three-phase stator of T_2 is in parallel with T_1, the magnitude of the voltage output of its single-phase rotor will be proportional to the vector sum of A_f and B_f as long as the servo system is balanced. The two outputs of the servo system, phase and amplitude, are amplified in the meter amplifiers and recorded.

Power Supply

In order to minimize effects of line-voltage fluctuations, a constant-voltage transformer was inserted to supply a constant input to the computing circuit. The current supplied to the field windings of the

two recorders is filtered by a low-pass filter and the total harmonic content of the 60-cycle frequency is reduced to less than 0.5 percent of the fundamental frequency. The recorders are of the dynamometer type, so harmonics of 60 cycles produced in the synchros and other parts of the instrument will not deflect the meters. One 300-volt regulated power supply supplies the B+ voltage for the summing amplifiers and meter amplifiers. Another 300-volt regulated power supply is used for the amplifiers of the servo unit.

Instrument Details

The photograph of the complete instrument shows the two dynamometer-type recorders mounted in the upper panel. The paper drive of each meter is linked to the main gear train through a clutch. The shaft extending through the left side panel to the clutch permits the paper drive of the left recorder to be either engaged or disengaged. A similar arrangement is provided for the right recorder.

The center panel contains all the dials and switches that have to be set for any particular problem. The twenty synchros are arranged in three rows, and the angular position of the stators may be set with corresponding dials. The dual potentiometers are also arranged in three rows, and their dials are located directly below the dials of the synchros. On the left of each synchro dial is a switch marked + and −, while underneath each potentiometer dial is a switch marked AN and SYN.

To synthesize, all the ± switches are set on +, and all the AN—SYN switches are set on SYN. When the instrument is used for analysis, all the AN—SYN switches are set on AN, and the ± switches are set according to the data used for the analysis. The synchro dials and potentiometer dials are numbered 1, 3, 5 . . . 39; the numbers correspond to the different harmonics in the case of synthesis, and to the different time intervals in the case of analysis.

An angle indicator at the upper left of the center panel shows the position of the rotor of the first synchro. The magnitude of deflection of the recorders can be adjusted by varying the gain of the meter amplifiers. Switches provide a coarse gain adjustment; a finer adjustment may be obtained by varying the amount of feedback of the amplifiers by means of controls located in the rear of the instrument. Another switch determines whether the outputs of the summing amplifiers are fed directly to the meter amplifiers, or connected to the inputs of the servo system.

When the servo is used, the output of a 10-turn Helipot gives a voltage corresponding to the phase angle. The servo system is then limited to a maximum phase-angle variation of 3,600 degrees, since the Helipot is geared directly to the synchro. The servo system may be set to any one of the ten existing balance positions at the beginning of each run by using a phase centering switch.

The a-c power supply is located in

Table I—Data to be Inserted in Analyzing Square-Wave Response of an Amplifier having the Frequency-Response Curve Shown in Fig. 7A

Harmonic	Freq. (mc)	Amp.	Normal. Amp.	Phase (deg)
1	0.25	100	94	− 6
3	0.75	104	98	− 21
5	1.25	106	100	− 37
7	1.75	104	98	− 59
9	2.25	95	89.5	− 78
11	2.75	83	76	−101
13	3.25	70	66	−118
15	3.75	53	50	−129
17	4.25	42	39.5	−144
19	4.75	30	28	−151
21	5.25	25	23.5	−157
23	5.75	20	19	−160
25	6.25	16	15	−163
27	6.75	14	13	−165

Table II—Data to be Inserted for Analyzing the Step Response of an Amplifier having Unit-Step Response represented by the Curve in Fig. 7B

Intervals	Time (μsec)	Amp.	Step $(A_n - A_{n-2})$	Normal. Step
1	0.027	6	+ 6	+ 15.5
3	0.077	45	+39	+100
5	0.125	79	+34	+ 87
7	0.175	103	+24	+ 61.5
9	0.225	110	+ 7	+ 18
11	0.275	109	− 1	− 2.5
13	0.325	105	− 4	− 10.5
15	0.375	102	− 3	− 8
17	0.425	100	− 2	− 5
19	0.475	99	− 1	− 2.5
21	0.525	98	− 1	− 2.5
23	0.575	98	0	0
25	0.625	99	+ 1	+ 2.5
27	0.675	99	0	0

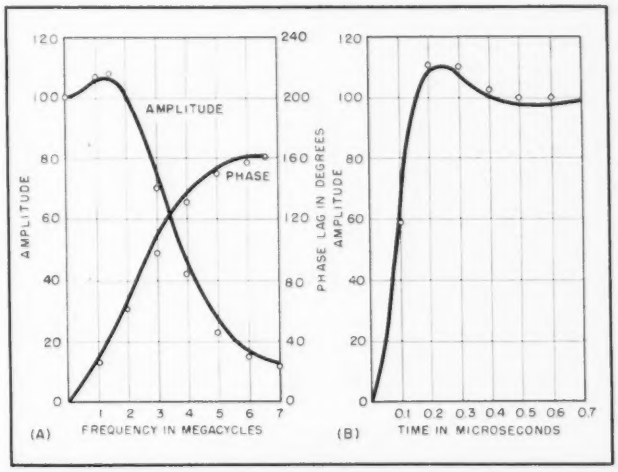


FIG. 7—Computed and measured frequency response (A) and unit-step response curves (B) for a typical amplifier

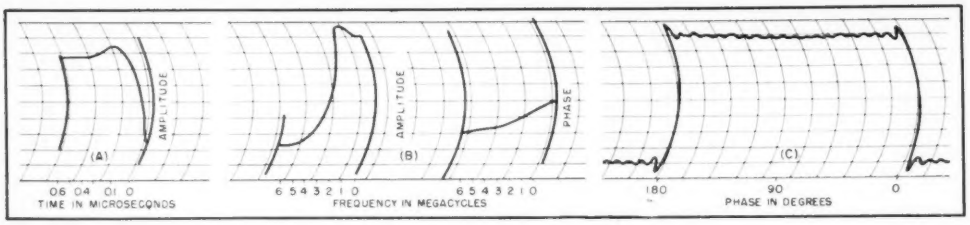


FIG. 8—Square-wave response (A) and typical frequency-response curves (B) for examples given in text. Curve (C) represents a square wave made up of all harmonics of equal amplitude and no phase shift

the bottom part of the instrument behind the lower panel. A lever arm extending through the lower panel actuates a clutch that disengages the gear train from the motor drive.

Circuit diagrams of the summing amplifiers and meter amplifiers are shown in Fig. 5 and 6. The internal gain of the summing amplifier is of the order of 20,000; with feedback, the gain is unity with the output potentiometer set at maximum.

Operation and Performance

The following examples have been chosen to demonstrate the operation of the instrument.

In order to operate the analyzer, it is most convenient to present the data to be inserted in tabular form. Suppose, it is desired to obtain the square-wave response of the amplifier whose frequency response is shown by the curves in Fig. 7A. We have to choose first the fundamental frequency of the square wave to be synthesized. In this case, 250 kc has been taken as the fundamental, and Table I gives the values of the response for all the harmonics to be used. Since the largest value that may be inserted for the amplitude is 100, it is necessary to compute the relative amplitudes in such a way as to make the largest amplitude equal to or smaller than 100. This has been done in the column labeled Normalized Amplitude. The values in the two last columns are set on the amplitude and phase dials of the analyzer.

If the fundamental frequency that has been chosen is too low, it will not be possible to use enough harmonics, and it is probable that the square-wave response will show a marked overshoot due to the Gibbs effect. If the frequency of the fundamental is too high, the amplitude of the response curve will not become constant. In this latter case, the curve obtained may give a true picture of the square-wave response, but that response would normally be of little interest.

Figure 8A shows the square-wave response obtained from the analyzer. Figure 7B shows the computed response of the amplifier to a unit step. The points shown on Fig. 7B were taken from Fig. 8A, and it is seen that the synthesized curve gives a good approximation to a unit-step response.

The responses given in Fig. 7 may also be used to check the results of a square-wave analysis. To analyze the unit-step response of Fig. 7B, it is again convenient to present the data in tabular form as shown in Table II. The time interval chosen in this case is 0.025 μsec. The amplitude dials of the instrument are set according to the data given in the last column of Table II. Figure 8B shows the two curves obtained in this case; points of these curves are represented on Fig. 7A.

The accuracy of the curves obtained is of the order of ±2 percent of full scale. This means that the curves obtained coincide within 2 percent with curves calculated by the same method. It is well known that the accuracy of the method depends upon the shape of the curve to be analyzed, and upon the number of intervals used.

The instrument may also be used to synthesize different waveforms, as long as the waveforms may be represented by a Fourier sine or cosine series containing only odd harmonics. A symmetric sawtooth wave belongs to that family of waveforms, its Fourier series being:

$$f(\omega t) = \sin \omega t - \frac{1}{3^2} \sin 3\omega t + \frac{1}{5^2} \sin 5\omega t - \ldots .$$

The response of a network to this wave may be obtained in a way similar to the one for the square-wave response. The amplitude response of any harmonic has to be divided by the square of the order of the harmonic, and the sign of the amplitude will be set according to the series.

The instrument can only be used for analysis or synthesis of waveforms for which twenty representative terms are sufficient. For most practical problems this number is not needed, but it may in some exceptional cases be a limitation. This limitation can be seen on Fig. 8C where a perfect square wave has been synthesized using all harmonics with equal amplitude and no phase shift. The response curve shows an overshoot due to the Gibbs effect, and small oscillations due to the finite number of harmonics used.

The instrument has been in use for some time, and only very few cases have arisen where it would be desirable to have more than twenty terms.

Acknowledgement

The author wishes to express his appreciation to A. W. Vance, E. A. Goldberg and H. Branson for their contribution in various phases of the work, and to V. K. Zworykin for his encouragement in the execution of the project.

Panoramic Sweep Circuits

Twelve methods of obtaining sweep voltages for panoramic receivers, f-m signal generators and r-f spectrum analyzers. Two methods are electronic, one is electrodynamic, and the others involve motor drives of capacitors, disks or potentiometers

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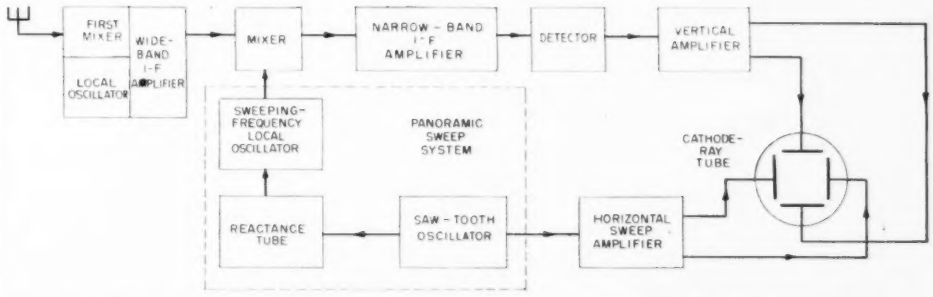
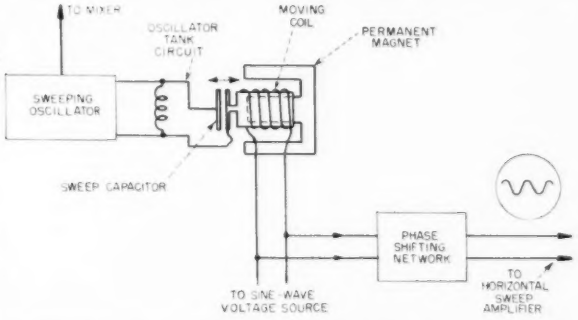
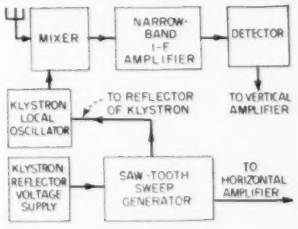


DOUBLE SUPERHET—Most widely used type of panoramic receiver. Second oscillator is frequency-modulated by reactance tube. Each of band of signals entering receiver will beat with local oscillator and pass through wide-band i-f amplifier. At second mixer, each signal is mixed in turn with output of sweeping oscillator, to form series of signals which pass through narrow-band amplifier and eventually appear as vertical deflection on c-r tube. Since oscillator frequency is function of sweep voltage, signals will be positioned across base-line according to their original frequency. No moving parts, but there is limit to sweep bandwidth.

As with other panoramic receivers which operate on receiver i-f, this scheme is useful in identifying signal images and other spurious responses. If receiver is tuned in given direction (say increasing frequency), all true responses will move across the screen from right to left. Image responses will move in opposite direction. Harmonic responses (signals beating with harmonics of receiver local oscillator) may be identified by the rate at which trace moves across screen as receiver is tuned.



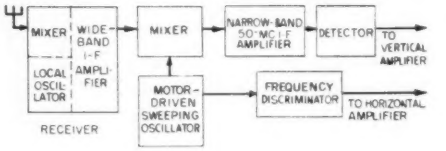
VIBRATING SWEEP SYSTEM—Similar to that in dynamic loudspeaker, driving sweep capacitor whose capacitance change is proportional to displacement from center position. Since coil displacement is proportional to voltage across coil, change in frequency of sweeping oscillator will also be proportional to voltage across coil. Sine wave is used to drive coil, resulting in sinusoidal variation of frequency with time. Spot displacement is linear with frequency, since sine wave is also used for sweep. Since there are two responses per cycle, phase-shifting network is used to make the two traces coincide on c-r screen. One advantage of this type of circuit is that amount of frequency swing is easily adjustable.



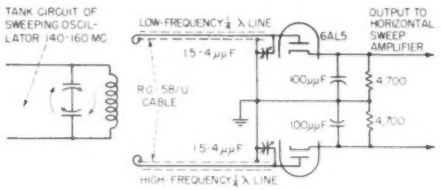
KLYSTRON SUPERHET—Applying sawtooth voltage in series with klystron reflector-voltage supply varies local oscillator frequency at sawtooth frequency. Since circuit has no image rejection, center frequency of narrow-band i-f amplifier must either be made so low that the two responses nearly coincide, or so high that image response is rejected by mixer or antenna circuits. Also, there is no way of identifying images by their direction of motion on c-r tube as receiver is tuned, which can be done with all other circuits described.

(continued on page 112)

PANORAMIC SWEEP CIRCUITS (continued from page 111)

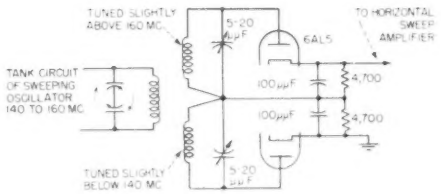


MOTOR-DRIVEN OSCILLATOR—Useful in receivers where band to be swept is greater than that obtainable by reactance tube method. Frequency modulation of oscillator is accomplished by motor-driven capacitor. Sweep voltage is obtained by coupling frequency discriminator to oscillator. Oscillator output must be constant over frequency range, as discriminator is sensitive to amplitude as well as frequency changes. A ratio detector circuit can be used, although this refinement is not usually necessary.

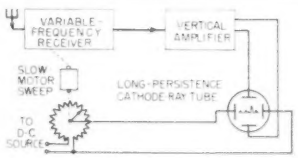


Example 1—Use with microwave receiver having 200-mc i-f amplifier with bandwidth of 20 mc. To minimize spurious responses caused by harmonics generated in mixer, 50-mc value is chosen for narrow-band amplifier and range of 140 to 160 mc for sweeping oscillator.

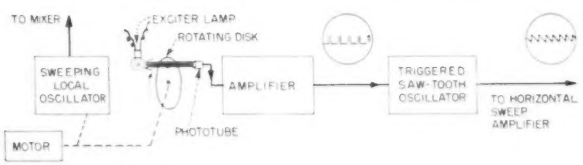
Discriminator has two resonant circuits coupled to oscillator, each having separate detector. One circuit resonates just above highest frequency of oscillator, and other is just below lowest oscillator frequency. At center frequency, diode outputs cancel; at other frequencies they combine to give direct voltage which varies linearly with frequency.



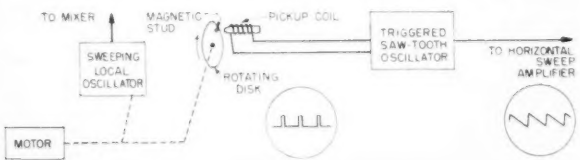
Example 2—Useful at frequencies where it is difficult to maintain simple lumped-constant circuits. Output of resonant-line discriminator is balanced with respect to ground, permitting grounding outer conductors of both coaxial lines. No phase-inverter stage is needed to push-pull amplifier for c-r tube. Output of discriminator is about 0.5 volt per mc. With discriminator-type sweeps, oscillator frequency can be varied in any convenient way, without following any definite law of frequency vs time.



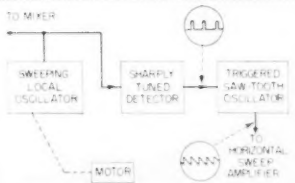
MOTOR-DRIVEN POTENTIOMETER—Used where low sweep frequency is allowable. Sweep voltage is obtained by coupling a potentiometer (which may be horizontal centering control) to motor drive. Received signals will remain visible 5 to 10 seconds, so motor drive must tune receiver through entire frequency band in less than 10 seconds. If there is no backlash in mechanical system, signals received on return sweep will coincide to form single trace. Especially useful where wide frequency band must be covered and receiver must have high sensitivity.



PHOTOTUBE-TRIGGERED SWEEP—May be used if sweep rate of local oscillator does not vary widely. Hole in motor-driven disk should be shaped to give as sharp a light pulse as possible, to avoid jitter in horizontal sweep voltage. Does not require close tolerances between disk and phototube.



MAGNETICALLY TRIGGERED SWEEP—Trigger pulse is generated by magnetic pickup coil. By careful design of magnetic circuit, enough voltage can be developed to trigger sweep oscillator directly. Mechanical tolerances must be close if device is to generate stable sweep voltage.



DETECTOR-TRIGGERED SWEEP—Part of output from sweeping local oscillator is fed to detector that is tuned to minimum frequency of oscillator. Output voltage pulse is thus generated each time sweeping oscillator frequency equals that to which detector is tuned, at end of oscillator range. This pulse is used to trigger sweep oscillator.

As with other triggered sweeps, sweep speed must be maintained reasonably constant. If speed changes greatly, saw-tooth oscillator may trigger at slightly different phase, causing jitter in horizontal trace. Also, if sweep speed is low, sweep becomes nonlinear, affecting frequency calibration of c-r tube.

(continued on page 114)

from terminal strips to sub-miniature sockets

Terminal strips

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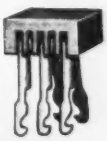
Sub-miniature sockets for printed circuit

(Enlarged)



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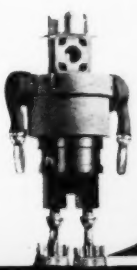

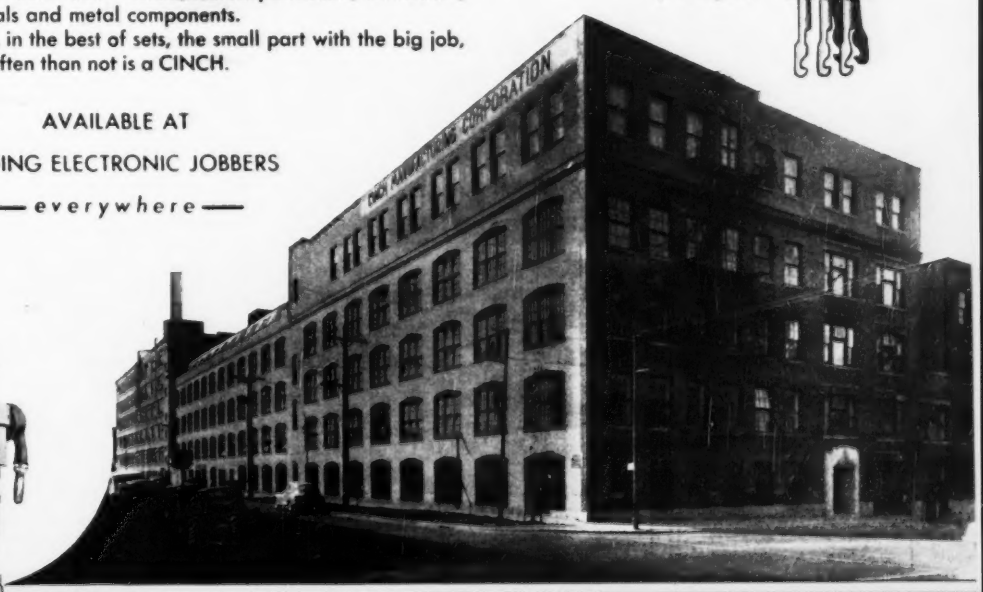

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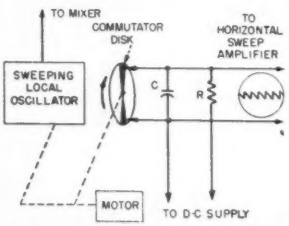
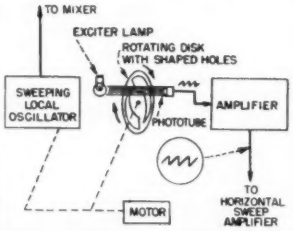
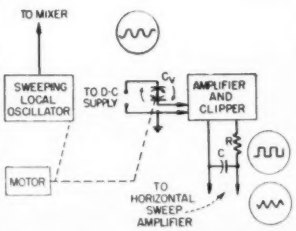
PANORAMIC SWEEP CIRCUITS (Continued from page 112)



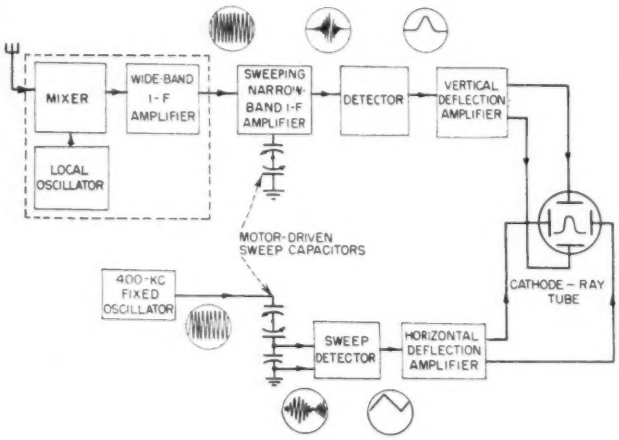
MOTOR-DRIVEN COMMUTATOR—Simple and quite practical if sweep speed is not high. Capacitor *C* charges through *R* while brushes are running on insulated section of commutator. When conducting segments come under brushes, *C* discharges through commutator, giving saw-tooth sweep voltage across *C*. Sweep voltage can be made large enough to apply to c-r tube plates directly without amplification.



PHOTOELECTRIC SWEEP GENERATOR—Amount of light reaching phototube is determined by size of opening in rotating disk. By properly shaping opening, desired saw-tooth output can be obtained. Since no *RC* circuits are involved, sweep is practically independent of sweep rate. Main objection to this type of circuit is that exciter lamp supply must be regulated.



CLIPPED-WAVE SWEEP GENERATOR—Motor-driven capacitor C_v modulates d-c supply at sweep frequency. Amplifier output is clipped to form square wave and integrated by *RC* circuit to form a back-to-back saw-tooth wave. Resistor *R* should be made larger than reactance of *C* at sweep frequency. Must be operated at constant speed, as output voltage is proportional to sweep frequency.

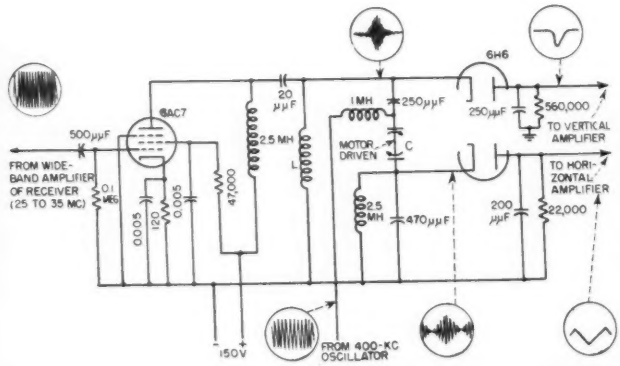


SWEEPING I-F AMPLIFIER—Used successfully in receiver having i-f of 30 mc and a 10-mc bandwidth. Output of wide-band i-f amplifier is fed to narrow-band i-f amplifier, frequency of which is determined by motor-driven capacitor. Resonant frequency of narrow-band amplifier is varied from 25 to 35 mc, and its output is rectified and applied to vertical plates of c-r tube. As capacitor sweeps across range, output of this stage varies, reaching maximum as resonant frequency coincides with input signal frequency.

Horizontal sweep is generated by using rotating capacitor to amplitude-modulate voltage from 400-kc sine-wave oscillator. Resulting voltage is demodulated in sweep detector, as indicated in block diagram, giving required saw-tooth sweep. Actually, only a single motor-driven capacitor is required for sweeping narrow-band amplifier and generating sweep voltage, as shown in schematic diagram.

Blanking of c-r tube is not required since sweep voltage has same value for given position of capacitor regardless of whether frequency of narrow i-f stage is increasing or decreasing. The sweep rate can be made very low or even zero and presentation will still be correct, providing d-c deflection amplifiers are used.

Resolution of 1 mc can be obtained with 10-mc sweep width described, using ordinary lumped-constant circuit elements. Better resolution can be obtained by using coaxial line circuits, although these are bulky unless intermediate frequency is considerably higher than 30 mc.



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Livestock Weighed by Electronic Equipment 116
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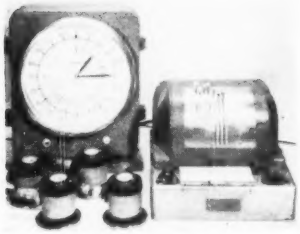

Complete electronic weighing set includes four strain-gage units, a printer and the main indicating dial

Livestock Weighed by Electronic Equipment

AN ELECTRONIC weighing instrument introduced recently is said to weigh animals accurately even though they move about on the weighing platform. That this claim is justified was proved when two prize bulls were led on to the platform to be weighed. Each resented the other's presence, and a violent fight followed, resulting in the smashing of the retaining wall surrounding the weighing platform. The electronic weighing instrument was the victor, however, for the combined weight of the pair of animals was measured and recorded despite the lack of cooperation from the struggling animals.

The instrument was developed as a specialized adaptation of automatic, electronic weighing, after a study of weighing conditions in many representative stock yards throughout the country, in an effort to eliminate some of the characteristic limitations of the weighbeam type of scale. The equipment can be installed in an hour or so as replacement for the lever system of an existing scale or in an entirely new installation where it will allow economies in excavating and pit construction costs.

The heart of the equipment is a set of four strain gage units, or weighing cells, which are placed under the corners of a weighing platform. Each unit consists of four bridge-connected resistance strain gages.

The bridges are energized with a 375-cps signal from an oscillator, as shown in the accompanying block diagram. The instrument is of the self-balancing type and the weight on the platform is indicated on a large, illuminated dial on which each 5/32-inch division is equal to one ten-thousandth of full scale which, in the livestock weighing application, is 50,000 pounds. Indication is provided by two radial hands, one of which revolves once while the other passes through 50 revolutions. The equivalent scale length is 125 feet.

The circuit for high-speed applications, such as track scales, has about three seconds delay before it comes to rest at full scale, and proportionately less delay for intermediate readings. Accuracies of the order of 0.01 percent of full scale or one dial division are obtainable with the instrument.

Operator sets up information to be printed, along with weight of cattle, by electronic live stock weighing instrument. Old beam-type scale may be seen in background. Scale is calibrated from zero to 50,000 pounds.

Automatic Operation

The equipment includes an automatic printing unit (similar in appearance to a cash register, as shown in the photograph), and will accommodate a scale ticket eight inches in length. Certain of the records made by the printer on the tickets are entirely automatic, such as weight, time and date, scale number and the number of the weighing being made. Other information is set in by hand and imprinted on the ticket simultaneously with the automatic data.

For the livestock scale, provision has been made for the type and number of livestock and

SOLDERING TIPS

Good soldering technique and maximum efficiency demand uniformity in the flux content, strand size, core size, and alloy of the solder. If any of these qualities are lacking, it means that from time to time there will be a marked difference in the results and the resulting loss in economy.

As an example, a solder that does not contain a uniform flux content might result in too much residue, which may be very harmful to the finished work; or in direct opposite, there might not be enough flux to properly remove the oxides, resulting in a faulty soldered connection. All Kester Flux-Core Solders are made with various core sizes containing a flux content ranging from 1½ of 1% to as much as 7% by weight. These core sizes are available in each of 68 different strand sizes, ranging from .009 to .250". Not too much emphasis can be placed upon the importance of the correct core and strand size in relation to the specific job that must be done.

A very important factor in controlling core sizes is that various core sizes or openings can only be obtained by making the solder with a **single core.** Multiple core solders have insufficient flexibility in their flux content to meet the many fluxing situations encountered in industry today. With Kester you have a single core, but that single core is available in six different sizes or openings designed to provide varying percentages of flux, so essential to precision soldering.

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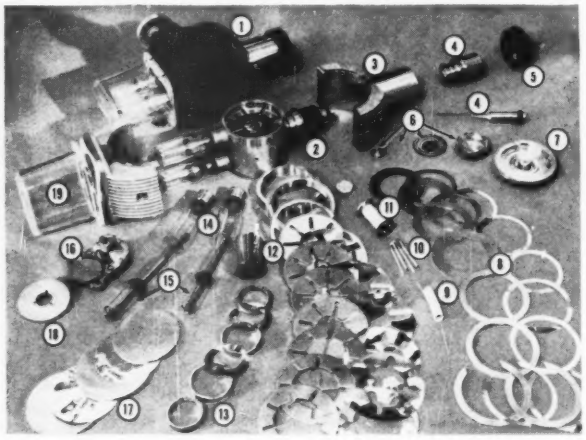
THE FRONT COVER

MODERN high-power pulsed radar magnetrons like Raytheon's 5J26 are built up from a large number of simple parts, as illustrated in color on the cover of this issue. Laminated construction from precision punchings gives lower production cost than machining from solid blocks, with no sacrifice in performance. Peak power output is 600 kilowatts for a maximum duration of 6 microseconds, with air cooling; peak anode current is then 60 amperes. Frequency range is tunable from 1,220 to 1,350 mc by means of the tuning gear assembly identified below. The cathode, also identified, is of the unipotential oxide-coated type, with 2.3 amperes at 23.5 volts on the heater. The tube is produced by the Power Tube Division of Raytheon Mfg. Co., in Waltham, Mass.

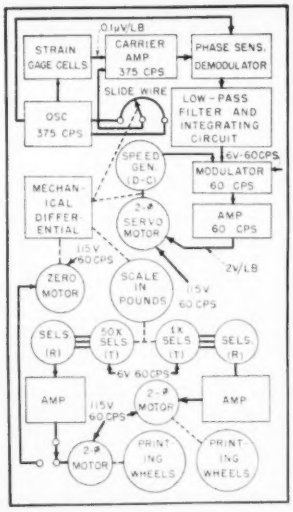


(1) Complete tube
(2) Mount assembly
(3) Radiator top
(4) Output pipe parts
(5) Output pipe guard
(6) Tuning cover parts
(7) Tuning cover unit
(8) Tuning cover parts
(9) Heater
(10) Heater insulators
(11) Cathode
(12) Anode assembly parts
(13) Anode straps
(14) Cathode pipes
(15) Heater pipes
(16) Timing gear assembly
(17) Plain covers
(18) Tuning wheel
(19) Base tube insulator

the symbol of the commission agent. The printed information can, of course, be adapted for any particular industry and made, within reasonable limits, to tie in with office accounting systems.

A system of selsyns causes the weight printing wheels to follow the reading of the large dial, which, on the 50,000 pound scale, would be to the nearest 5 pounds. Printing is completely digital, eliminating estimation between divisions and, in addition, multiple, remotely located printers are contemplated which may be operated simultaneously with the one at the actual weighing location.

The unbalance signal is amplified and demodulated, and the resulting d-c signal, which fluctuates with the movement or swaying of the animals being weighed, is integrated to give an accurate average reading. The integrated signal is applied to a circuit which produces a 60-cps voltage, the magnitude of which is determined by the unbalance between weight and indication. This voltage, after being



Block diagram of electronic weighing instrument

amplified, drives a 2-phase motor which balances the instrument and, through a mechanical differential, drives the dial pointers directly and the printing wheels through the selsyn system.

A pushbutton is provided for automatic zeroing of the scale tare, working through the mechanical differential mentioned above, and another panel switch adds electrical damping across the servo-system amplifier for cases when the motion of the weighing platform becomes violent, as in the case cited at the beginning of this article.

The system is closer to being foolproof than any other known weighing device as nearly as its manufacturer, the Cox and Stevens Aircraft Corporation of Mineola, New York, has been able to determine. A printed weight can be obtained only when weight is indicated on the dial face and the latter can occur only when there is a load on the weighing platform. Besides livestock, similar units are being used to weigh freight cars as they roll past the inspection point without stopping, and to weigh large rolls of steel as they leave the strip mill at the rate of about one every five minutes, rolling across the scale platform in a few seconds.

(Continued on p 134)

Western Electric Power Tubes for AM and FM

WHETHER your station operates on low power or high power, AM or FM, you'll find the tubes you want in Western Electric's line.

Always known for long service life and top quality performance, these broadcast power tubes and rectifiers—all engineered by Bell Telephone Laboratories—are now being made for Western Electric by Machlett Laboratories, Inc., another pioneer in the development of electron tubes.

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220C	Water cooled triode, 10 kilowatts
220CA	Forced-air cooled triode, 5 kilowatts
222A	Water cooled high vacuum rectifier, 25 kv. inverse voltage
228A	Water cooled triode, 5 kilowatts
232B	Water cooled triode, 25 kilowatts
232BA	Forced-air cooled triode, 8 kilowatts
233A	Water cooled high vacuum rectifier, 50 kv. inverse voltage
236A	Water cooled triode, 20 kilowatts
240B	Water cooled triode, 10 kilowatts
241B	Air-cooled triode, 275 watts
251A	Air-cooled triode, 1000 watts
270A	Air cooled triode, 350 watts
279A	Air cooled triode, 1200 watts
298A and B	Water cooled triode, 100 kilowatts
308B	Air cooled triode, 250 watts
340A	Water cooled triode, 25 kilowatts
341AA	Forced-air cooled triode, 5 kilowatts
342A	Water cooled triode, 25 kilowatts
343A	Water cooled triode, 10 kilowatts
343AA	Forced-air cooled triode, 5 kilowatts
357B	Air cooled triode vhf, 400 watts
363A	Air cooled pentode, vhf, 350 watts
379A	Air cooled triode, 1200 watts
5530	Forced-air cooled triode, vhf, 3 kilowatts
5541	Forced-air cooled triode, vhf, 10 kilowatts

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THE ELECTRON ART

Edited by JOHN MARKUS

Double-Stream Amplifier 120
Transistor Beat-Frequency Oscillator and Amplifier 120
Eliminating Aging Effects in Quartz Crystals 122
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Double-Stream Amplifier

EXPERIMENTAL confirmation of a gain-predicting theory for double-stream amplifier tubes was announced by A. V. Hollenberg of Bell Laboratories in the Aug. 1949 issue of Bell Laboratories Record. This theory, worked out by J. R. Pierce and W. B. Hebenstreit of the Labs, is believed to be valid for small signals, small differences in electron speed and cylindrical streams. It states the conditions to be satisfied in order that amplification may occur in two streams of electrons and predicts the amount of gain to be expected.

The elements of a double-stream amplifier tube are shown in Fig. 1. The signal to be amplified is impressed on both electron streams near their beginning of travel and is extracted from the streams near their end. In the space between, the signal grows because of interaction between the two streams. The two concentric cylindrical streams of electrons are emitted by two annular cathodes that are at different potentials with respect to the accelerating grid. After acceleration, the streams travel together for perhaps a foot or more down the tube, through input and output helixes that couple the streams to the signal input and output circuits. A third coil is wound around the outside of the entire tube to produce a magnetic field that holds the electron streams to a cross-section about the same as that of the cathodes.

Like the traveling-wave amplifier, the double-stream amplifier is able to amplify with high gain over a broad band of frequencies. Because there is no metal structure in the amplifying mechanism, the tube offers promise even at the highest microwave frequencies. Since the tube is many wavelengths long in terms of the wave that travels on the electron streams, each electron participates in the amplifying process during a large number of cycles of the signal. The gain is directly proportional to the number of wavelengths in the amplifying region.

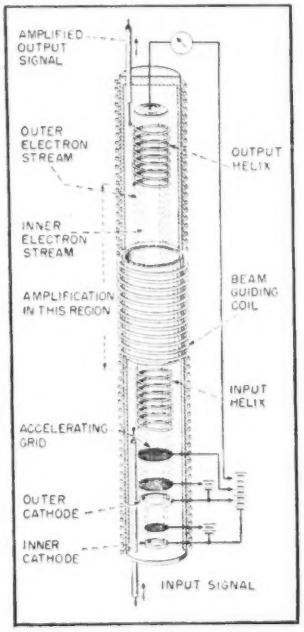

FIG. 1—Essential elements of double-stream amplifier tube

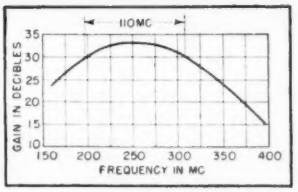

FIG. 2—Gain curve of double-stream amplifier

The experimental tube employed amplifies over the band from about 200 to 300 mc with a maximum gain of 33 db, as indicated in Fig. 2. As current densities in the electron streams are increased, gain increases rapidly at first and then approaches a limiting value of about 27 db per wavelength in the streams per unit velocity separation. The latter term is defined as the difference in velocity between the two streams divided by the average velocity, and has values of the order of 0.1. For a tube 16 wavelengths long with this velocity separation, for example, the limiting gain would be 27 x 16 x 0.1 or about 43 db. Gain varies slowly enough with frequency so that bandwidth is comparable to that in helix traveling-wave amplifiers.

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L. S. Nergaard, Analysis of a Simple Model of Two-Beam Growing-Wave Tube, *RCA Review*, p 585, Dec. 1948.

A. V. Hollenberg, The Double Stream Amplifier, *Bell Laboratories Record*, p 290, Aug. 1949.

J. R. Pierce, Double-Stream Amplifiers, *Proc. IRE*, p 980, Sept. 1949.

Transistor Beat-Frequency Oscillator and Amplifier

THE ACCOMPANYING oscillator circuit using crystal tetrodes was demonstrated by Stuart T. Martin, chief engineer of Sylvania's Electronics Division, at a recent meeting of the Radio Club of America in New York City.

Using Sylvania GT372 transis-

Laboratory Instruments for TELEVISION

Type 202-B
FM SIGNAL GENERATOR

Frequency Range
54-216 mc.

Additional coverage from 0.4 to 25 mc. with accessory UNIVERTER Type 203-B

FM SIGNAL GENERATOR
Type 202-B

The Type 202-B FM Signal Generator is specifically designed to meet the exacting requirements of television and FM engineers working in the frequency range of 54 megacycles to 216 megacycles. Following are some of the outstanding features of this versatile instrument:

RF RANGES: 54-108, 108-216 mc. ± 0.5% accuracy. Also covers 0.4 mc. to 25 mc. with accessory 203-B Univerter.
VERNIER DIAL: 24:1 gear ratio with main frequency dial.
FREQUENCY DEVIATION RANGES: 0-24 kc., 0-80 kc., 0-240 kc.
AMPLITUDE MODULATION: Continuously variable 0-50%, calibrated at 30% and 50% points.
MODULATING OSCILLATOR: Eight internal modulating frequencies from 50 cycles to 15 kc. available for FM, AM.
RF OUTPUT VOLTAGE: 0.2 volt to 0.1 microvolt. Output impedance 26.5 ohms.
FM DISTORTION: Less than 2% at 75 kc. deviation.
SPURIOUS RF OUTPUT: All spurious RF voltages 30 db or more below fundamental.

If you have an FM or television instrument requirement, let us acquaint you with full particulars and technical data concerning the Type 202-B FM Signal Generator and Type 203-B Univerter.

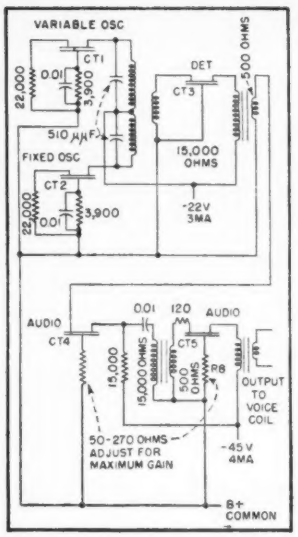
UNIVERTER
Type 203-B

AVAILABLE AS AN ACCESSORY is the 203-B Univerter, a unity gain frequency converter which, in combination with the 202-B instrument, provides the additional coverage of commonly used intermediate and radio frequencies.

R. F. RANGE: 0.4 mc. to 25 mc. (0.1 mc. to 25 mc. with no carrier deviation).
R. F. INCREMENT DIAL: ± 250 kc. in 10 kc. increments.
R. F. OUTPUT: 0.1 microvolt to 0.1 volt, ± 1 db. Also approximately 2 volts maximum (uncalibrated).
OUTPUT IMPEDANCE: Approximately 60 ohms at 0.1 volt jack, 470 ohms at 2 volt pin jack.

BOONTON RADIO Corporation
BOONTON · N·J · U·S·A

DESIGNERS AND MANUFACTURERS OF THE Q METER · QX CHECKER FREQUENCY MODULATED SIGNAL GENERATOR · BEAT FREQUENCY GENERATOR AND OTHER DIRECT READING INSTRUMENTS



Beat-frequency oscillator and amplifier circuit using Sylvania GT372 transistors

tors, power output was between 2 and 5 milliwatts across a reflected load of 15,000 ohms. With the component values indicated, the audio-frequency range was from 300 to 30,000 cps. No attempt was made to minimize locking in of the two 250-kc oscillators, hence the low-frequency end of the range was limited to 300 cps. The r-f oscillators each delivered from 3 to 5 volts rms. Waveform distortion of the audio output was approximately 10 percent at 1,000 cps. In general,

Eliminating Aging Effects in Quartz Crystals

A NEW PROCESS, discovered by scientists of the Frequency Control Branch of the Signal Corps Engineering Laboratories at Fort Monmouth, N. J., virtually eliminates the aging characteristics of quartz crystals, and at the same time improves their efficiency.

Finished blank crystals are placed on a conveyor belt and drawn through an electrically heated oven at approximately 900 F for two to three hours, then cooled under carefully controlled conditions for 24 hours.

Eliminating of aging effects is expected to reduce maintenance costs of both military and commercial communication and entertainment broadcasting equipment using crystal control of carrier frequency. Increase of efficiency is likewise expected to make possible smaller, lighter and better walkie-talkie, aircraft, tank and combat radios used by the U. S. armed services. It is estimated that replacement of aged and unsatisfactory communication crystals in World War II involved an expense of some hundred million dollars.

Oven used in initial trials of new Signal Corps process for eliminating aging characteristics of finished quartz crystal blanks. Development of process is credited to David G. McCaa (above), Arthur G. Prichard and Maurice A. A. Druesne, all Signal Corps physicists

Interlaced-Dot Color Television Announced by RCA

OPERATING PRINCIPLES of a new high-definition, all-electronic system of color television were revealed by RCA in an engineering statement submitted to the FCC on September 6, 1949, by E. W. Engstrom, vice-president in charge of research at RCA Laboratories.

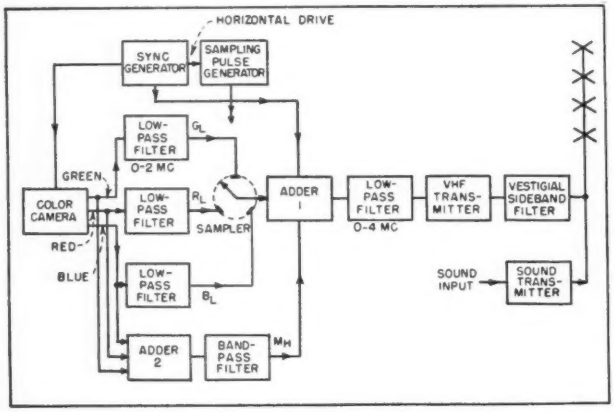


FIG. 1—Block diagram of RCA color television transmitter

The new system operates entirely within a 6-mc channel without degradation of the quality of the received pictures. No changes in present 525-line, 60-field-per-second transmission standards are required.

The field is still interlaced, and in addition the picture dots themselves are interlaced. Time multiplex transmission is used, giving 15 complete color pictures per second. Transmitting stations can change at will either from color to black-and-white or the reverse without disturbing the viewers of existing receivers or color receivers, without requiring adjustments to either type of receiver and, therefore, without any loss of audience;

(continued on page 172)

For Temperature Ranges from 500° F. to -85° F.

Varglas Silicone Electrical Insulating Tubing and Sleeving

Lead Wire and Tying Cord

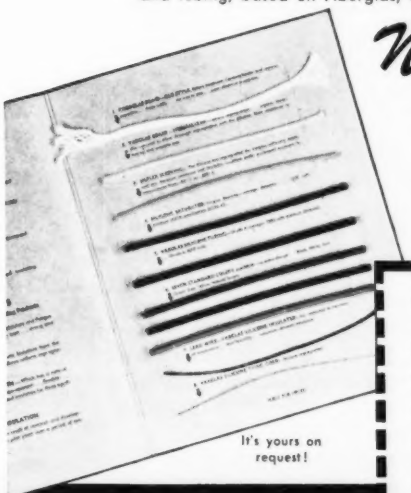
VARGLAS SILICONE is a sensationally new electrical insulating sleeving and tubing developed by our laboratory and pilot plant during the war. It is a product which combines Varglas and Silicone to bring revolutionary possibilities to electrical insulation.

VARGLAS SILICONE is efficient under a wide temperature range...to 500°F. or more in some applications, yet remains completely flexible at -85° F. It has excellent resistance to moisture and lubricating oil, is flame resistant and self-extinguishing, *and is the strongest of the accepted insulating materials.*

VARGLAS SILICONE, pioneered by VARFLEX CORPORATION, is the first combination of these outstanding features:

1. **VARGLAS**—Continuous filament Fiberglas—a moisture and fungus proof material which will not burn and is chemically inert—strong and flexible at high and low temperatures.
2. **NORMALIZING**—Removes binder and organic inclusions from the Fiberglas—improves electrical qualities and allows uniform impregnation.
3. **SILICONE HIGH TEMPERATURE RESIN**—Which has a natural affinity for the Fiberglas, renders it abrasion-resistant, flexible and non-fraying.

VARFLEX CORPORATION, manufacturers of electrical insulating tubing and sleeving, are insulation specialists. If you require special insulation, write us about your problems. We will gladly quote on your individual requirements or ASTM specifications. We have a complete line of sleeving and tubing, based on Fiberglas, cotton, and extruded plastics.



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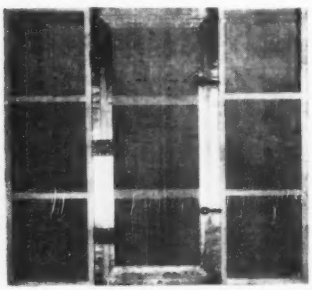
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Portable Shielded Room

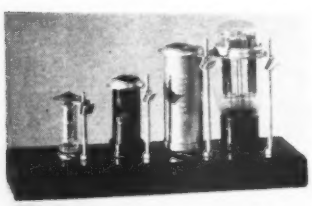
ACE ENGINEERING & MACHINE CO., 3642 North Lawrence St., Philadelphia 40, Pa. A new portable shielded room for use in laboratories and production lines is designed for a minimum of 100-db attenuation from 0.15 to 1,000 mc in fields as low as 1 microvolt per meter. The screening is double copper mesh arranged in sections so that the room can be enlarged or reduced in size.



There are seven standard sizes available, ranging from 8 × 8 × 5 feet 4 inches up to 16 × 8 × 16 feet. Provision is made for including a latched door and an entry section for power, gas, air and water facilities.

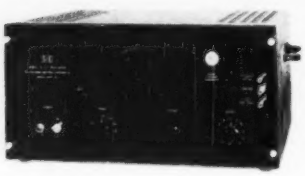
Plug-In Component Clamp

TIMES FACSIMILE CORP., 229 W. 43rd St., New York 18, N. Y. The Top Hat Retainer is an improved clamp useful for most applications where plug-in components are subjected to shock or vibration in portable, mobile, railroad and airborne communications equipment. Four standard sizes fit all glass or metal receiving tube types including the ST-16 envelope and plug-in capacitors or vibrators. Special sizes are available for transmitting or special-purpose tubes.



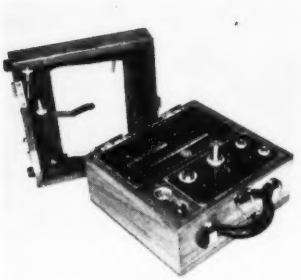
Wide-Range Oscillator

SOUTHWESTERN INDUSTRIAL ELECTRONIC CO., 2831 Post Oak Road, Houston, Texas. Model M oscillator was designed as a source of power with a frequency continuously variable from 1 to 120,000 cps in five overlapping ranges. The circuit is a new arrangement of the bridge-stabilized type of oscillator, using two separate amplifiers connected together by a four-terminal bridge network. One output circuit will deliver 20 volts across 1,000 ohms or 20 ma rms, and the other has a constant internal resistance of 250 ohms and an open circuit voltage of 1 volt. Power supply noise is less than 0.01 percent of the output signal. Harmonic distortion is less than 0.2 percent from 20 to 15,000 cps.



Engine Pressure Indicator

CONTROL ENGINEERING CORP., 863 Washington St., Canton, Mass. Model 2 DC engine pressure indicator gives accurate pressure readings at detonation and power stroke frequencies. The complete system consists of a catenary-diaphragm pressure pickup, an amplifier-power supply unit with all connecting cables included, and a standard oscilloscope (last item not furnished). Accuracy of the pressure pickup is ± 1 percent to over 20,000 cps with air cooling. Descriptive literature may be obtained on request.



Metal Picture Tube

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. Type 16AP4, the 16-inch metal direct view television tube, is supplied with a heater rated at 6.3 volts, a-c or d-c and 0.6 ampere for unipotential cathode. Magnetic deflection, focusing and ion trap auxiliaries are required. Operating voltage of the high-voltage anode is 12,000 volts; of the focusing anode, 300 volts; and of the control grid, -33 to -77 volts. Overall length of the tube is 22¼ in.

Super-Gain Tele Antenna

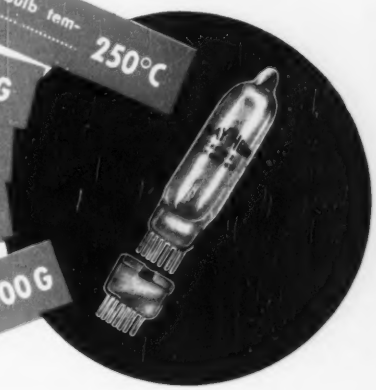
RADIO CORP. OF AMERICA, Camden, N. J., has developed a new super-gain television transmitting antenna consisting of dipole and screen combination units measuring 30 by 48 inches and weighing 100 pounds. The units are designed for directional mounting on the

NEW AND HIGHER RATINGS FOR

RAYTHEON CK5702/CK605CX

SUBMINIATURE TUBES

1. 500 hour life for maximum bulb temperature of ..... 250°C
2. Shock ratings similar to the "W" Military Ruggedized tube types 450G
3. Fatigue tested the same as Military Ruggedized tubes 2.5G for 96 hrs.
4. Long Life Reliability Rating 5000 hrs.
5. Centrifuge acceleration ratings for any position 1000G



This chart gives you at a glance the characteristics of representative Raytheon Subminiature Tubes

Type No.	Remarks	Maximum Diameter inches	Maximum Length inches	Filament Or Heater Volts	Filament Or Heater Ma.	Mutual Conductance umhos	Power Output mW.	TYPICAL OPERATING CONDITIONS Plate Volts	Plate Ma.	Screen Volts	Screen Ma.	Grid Volts
HEATER CATHODE TYPES												
CK5702, CK605CX	Characteristics of 6AR5	0.400	1.5	6.3	200	5000		120	7.5	120	2.5	-2.0
CK5703, CK606CX	Triode, UHF Oscillator, 3/4 watts at 500 Mc	0.400	1.5	6.3	200	5000		120	9.0			-2.0
CK5704, CK606RX	Diode, equivalent to one-half 6AL5	0.315	1.5	6.3	150			150ac	9.0			
CK5744, CK619CX	Triode, High mu	0.400	1.5	6.3	200	4000		250	4.0			-2.0
CK5784	Characteristics of 6AS6	0.400	1.5	6.3	200	3200		120	3.2	120	3.5	-2.0
FILAMENT TYPES												
1AD4	Shielded RF Pentode — high Gm	0.300x0.400	1.5	1.25	100	2000		45.0	3.0	45.0	0.8	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CK571AX	10 ma. Filament electrometer tube, Ig = 2x10⁻¹⁴ amps.	0.285x0.400	1.5	1.25	10	1.61		10.5	0.20			-3.0
CK573AX	Triode, high frequency output	0.300x0.400	1.5	1.25	200	2000		90.0	11.0			-4.0
CK574AX	Shielded Pentode RF Amplifier	0.290x0.390	1.25	0.625	20	371		22.5	0.125	22.5	0.04	-0.625
CK5672	Output Pentode	0.285x0.385	1.5	1.25	50	625	60.0	67.5	2.75	67.5	1.1	-6.25
CK5675, CK556AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	120	1600		135.0	4.0			-5.0
CK5677, CK568AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	60	650		135.0	1.9			-6.0
CK5678, CK569AX	RF Pentode	0.300x0.400	1.5	1.25	30	1150		67.5	1.8	67.5	0.48	0
CK5697, CK570AX	Electrometer Triode Max. grid current 5x10⁻¹⁵ amps.	0.285x0.400	1.25	0.625	20	1.51		12	0.22			-3.0
CK5785	High voltage rectifier	0.265x0.400	1.5	1.25	15				0.1	Inverse peak 3500 volts		
VOLTAGE REGULATORS												
CK5783	Voltage reference tube — like 5651	0.400	1.63	Operating voltage 85. Operating current range 1.5 to 3.5 ma.								
CK5787	Voltage regulator	0.400	2.06	Operating voltage 100. Operating current range 5 to 25 ma.								
CK [illegible]	RK [illegible]			(Voltage Gain (times)								

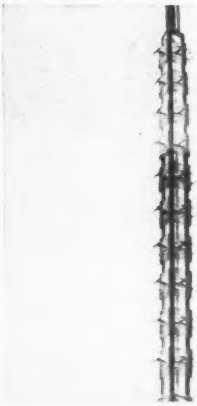
RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

SPECIAL TUBE SECTION - Newton 58, Massachusetts

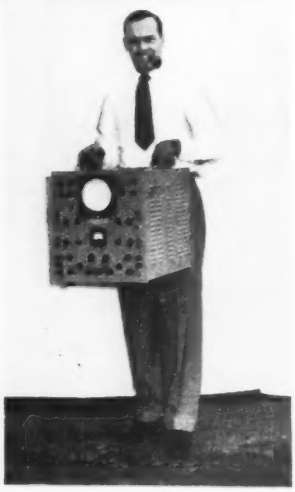
SUBMINIATURE TUBES • SPECIAL PURPOSE TUBES • MICROWAVE TUBES • CATHODE RAY TUBES • RECEIVING TUBES



face of any standard radio tower. A feature of the antenna is its ability to increase coverage of a television station in any desired direction. This is accomplished by stacking dipole and screen combinations above each other on the side of the tower facing in that direction, to achieve higher power gain. Conversely, units may be omitted or reduced in number on any side of the tower where signal interference with another station might result.

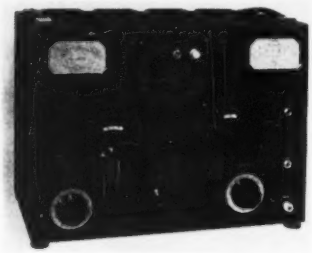
Dual-Channel Oscilloscope

ELECTRONIC TUBE CORP., 1200 East Mermaid Lane, Philadelphia 18, Pa. The new H-21 dual-channel oscilloscope contains two separate and complete electron guns in a single five-inch flat-face tube. Each channel has individual controls for intensity, focus, and X, Y and Z axes. Vertical deflection sensitivity is less than 0.1 volt d-c per inch. Triggering is in continuous sweeps from 2 cps to 50 kc, 0.5 second to 20 microseconds. Delay after triggering is less than one microsecond. The unit weighs 65 pounds.



Standard Signal Generator

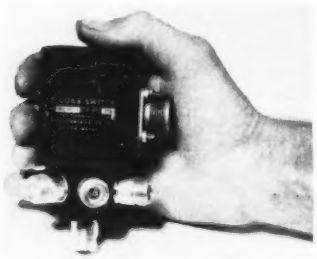
MEASUREMENTS CORP., Boonton, N. J. Model 82 standard signal generator covers the frequency range of 20 cycles to 50 mc. Two oscillators are employed. The l-f oscillator, continuously variable



from 20 cycles to 200 kc, has a metered output from 0 to 50 volts across a resistance of 7,500 ohms. A radio-frequency oscillator covering the range from 80 kc to 50 mc provides output from 0.1 μv to 1 volt and may be modulated with the l-f oscillator.

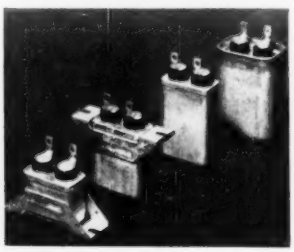
R-F Coax Switch

GENERAL COMMUNICATION CO., 681 Beacon St., Boston 15, Mass., has developed a radio-frequency coaxial switch which reduces reflection losses by maintaining coaxial configuration. It has a standing-wave ratio due to insertion in a well-matched transmission line of 1.5 to 1.0 or better at 10 kilomegacycles, lower at lower frequencies. Model 6N60RC-1 illustrated is a 6-position, remotely operated switch having the standard characteristic impedance of 50 ohms.



Small Capacitors

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has announced a new line of small d-c capacitors for use



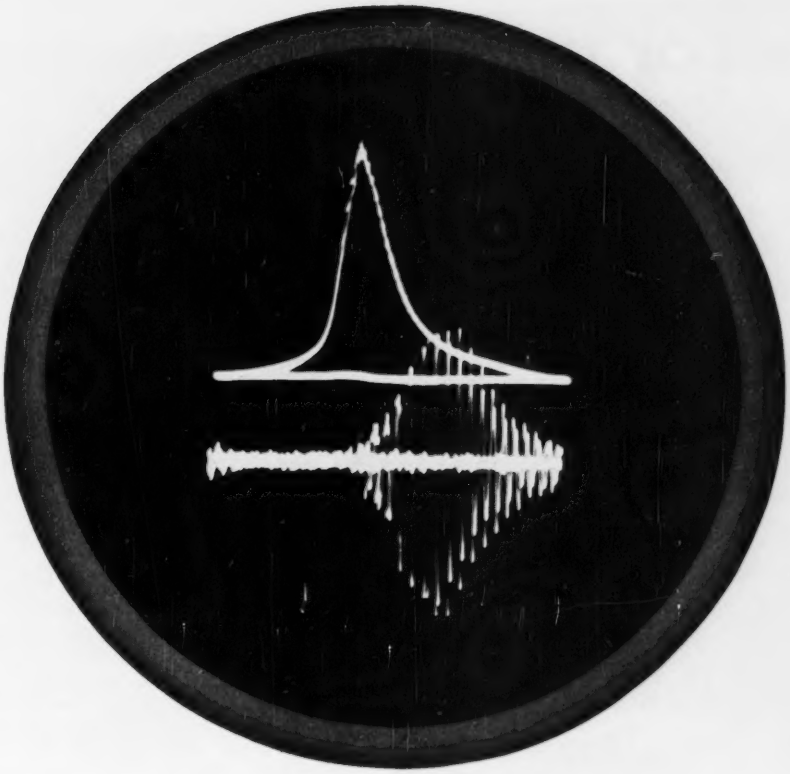
in ambient temperatures up to 125 deg C. These Permafil paper-dielectric capacitors, hermetically sealed in metallic containers, are available in ratings of 0.10 to 10.0 μf at 600, 1,000 and 1,500 volts. Permanently sealed silicone bushings are provided on all types.

Versatile Radiation Counter

THE NUCLEONIC CORP. OF AMERICA, 499 Union St., Brooklyn 31, N. Y. Model RC1 radiation counter com-

bines the functions of a scaling unit, a radiation survey meter, a count-rate meter and a contamination detector. Some of its features are: continuous 24 hour per day stable operation without overheating; bi-

(continued on p 200)



This is a picture of "PING"

This photographic record of an oscillograph trace shows, and times, the detonation in a "knocking" engine. Even if the trace itself lasted but a few hundred-thousandths of a second, photography gets it clearly and accurately as nothing else can.

That's the beauty of photographing oscillograph traces. It gives you the opportunity to study them carefully – to discuss them with others.

To photograph these traces most successfully, Kodak makes two Kodak Linagraph Films.

Kodak Linagraph Pan Film is the fastest film for the blue-emitting screens used for studying fast transients, and for the long-persistence red-emitting screens. Kodak Linagraph Ortho Film is for green-emitting screens.

In both of these you get the high density of line and the cleanness of background that give you maximum information from your traces. The films are supplied in cassettes for 35 mm. cameras and also in special 16 mm. and 35 mm. spoolings for several recording cameras.

Kodak Linagraph Films may be obtained from the Kodak Industrial Dealer in your area.

Eastman Kodak Company, Rochester 4, N. Y.

Instrument Recording

—another function of photography

Kodak

TRADE-MARK

NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

Mammoth Tele Assembly Plant Dedicated

THE WORLD'S largest television assembly plant, a 480,000-sq ft structure, was recently dedicated by Allen B. Du Mont Laboratories, Inc., at East Paterson, N. J. At full capacity the new plant will be able to produce one television receiver approximately every 22 seconds. Three 465-ft mechanized assembly conveyors are already in use. Installation of further receiver production lines may be made to meet demand.

The complete dedication ceremony, including a special telecast titled "The Du Mont Story" was transmitted from the plant to the New York-New Jersey area over WOR-TV, using Du Mont mobile equipment, and was seen over a ten-station hookup of the Du Mont television network. On hand for the function were special exhibits by various divisions of the DuMont organization. Included among the exhibits was the Telecruiser, a completely mobile television studio used for remote events.

Unveiling the bronze plaque at the dedication of the huge television assembly plant of Allen B. Du Mont Laboratories, Inc., East Paterson, N. J., are (left to right) New Jersey Governor Alfred E. Driscoll, Leonard F. Cramer, vice-president of the organization, and Allen B. Du Mont, president

URSI-IRE Fall Meeting

SIXTEEN papers on antennas and propagation have been planned for the URSI-IRE technical meeting being held in Washington, D. C., on October 31, November 1 and 2. The program is as follows:

October 31

Morning: Artificial Dielectrics

Development of Artificial Dielectric Optics in Germany, by O. M. Stuetzer of Wright-Patterson Air Force Base, Dayton, Ohio.

Artificial Dielectric Broadside and End-Fire Antennas, by W. E. Kock of Bell Laboratories, N. J.

Metal Plate Media—Mathematical Theory, by A. E. Heins of Carnegie Institute of Technology, Pittsburgh, Pa.

Metal Plate Media—Extension and Test of Theory, by B. A. Lengyel of Naval Research Laboratory, Washington, D. C.

Afternoon: Helical Radiators

The Helical Antenna, by J. D. Kraus of Ohio State University, Dayton, Ohio.

Transmission Modes and the Associated Radiation Fields of the Helical Antenna, by A. E. Marston of Naval Research Laboratory, Washington, D. C.

Modified Axial Mode Helices and Their Application to Arrays, by P. W. Springer of Aircraft Radiation Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

Helical Radiators as Broad-Band, Dragless, Circularly-Polarized Antennas, by J. A. Marsh of Ohio State University Research Foundation, Columbus, Ohio.

November 1

Morning: Elliptically Polarized Antennas

Transmission and Reception by Arbitrary Antenna Systems, by G. Sinclair of University of Toronto, Toronto, Canada.

Antenna Relations for Elliptical Polarization, by J. I. Bohnert of Naval Research Laboratory, Washington, D. C.

On the Representation and Analysis of Polarization Characteristics, by V. H. Rumsey and T. E. Tice of Ohio State University Research Foundation, Columbus, Ohio.

On the Relation Between The Impedance Characteristic And The Polarization Characteristic of Two Interconnected Orthogonal Radiators, by P. I. Pressel of Ohio State University Research Foundation, Columbus, Ohio.

Afternoon: Fields Near Apertures and Obstacles

Fields Near Apertures and Obstacles, by S. Silver of University of California, Berkeley, Calif.

The Field of a Horn Radiator and the Modification Produced in its Far Field by an Obstacle in its Near Field, by G. A. Woonton of McGill University, Montreal, Canada.

Diffraction by a Cylindrical Obstacle, by C. H. Papas of Cruft Laboratory, Harvard University, Cambridge, Mass.

An Experimental Investigation of Electromagnetic Diffraction at 1.25 cm, by R. D. Kodis of Cruft Laboratory, Harvard University, Cambridge, Mass.

RMA Parts Section Chiefs

TWENTY chairmen of sections of the RMA Parts Division, recently announced by chairman A. D. Plamondon of Indiana Steel Products Co., Chicago, Ill., are as follows:

Antenna—G. O. Benson of Premax Products Division of Chisholm-Ryder Co., Inc., Niagara Falls, N. Y.

Coil—Edwin I. Guthman of Edwin I. Guthman & Company, Inc., Chicago, Ill.

Ceramic Capacitor—K. E. Rollefson of The Muter Company, Chicago, Ill.

Fixed Capacitor—W. Myron Owen of Aerovox Corp., New Bedford, Mass.

Fixed Resistor—D. S. W. Kelly of Allen-Bradley Company, Milwaukee, Wisc.

Instrument & Test Equipment—R. L. Triplett of Triplett Electrical Instrument Co., Bluffton, Ohio.

Metal Stampings & Metal Specialties—Jay H. Johnson of Johnson & Hoffman, Inc., Rockville Centre, N. Y.

Phonograph Cartridges, Pickups & Microphones—S. N. Shure of Shure Brothers, Inc., Chicago, Ill.

Record Changers & Phono-Motor Assemblies—R. E. Laux of General Instrument Corporation, Elizabeth, N. J.

Socket—Lester W. Tarr of Cinch

The MOST VERSATILE AND SENSITIVE Oscilloscope EVER Built!

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WITH SPECIAL REDUCTIONS TO TECHNICAL SCHOOLS AND NON-PROFIT ORGANIZATIONS

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Speaker Parts—Wm. H. Welsh of Wm. H. Welsh Co., Inc., Chicago, Ill.

Special Products—W. R. MacLeod of King Laboratories, Inc., Syracuse, N. Y.

Switch—W. S. Parsons of Centralab, Div. of Globe-Union, Inc., Milwaukee, Wisc.

Transformer—L. S. Racine of Chicago Transformer Division, Chicago, Ill.

Tube Parts—S. L. Gabel of Superior Tube Co., Norristown, Pa.

Variable Condenser—Russell E. Cramer, Jr. of Radio Condenser Company, Camden, N. J.

Variable Resistor — Victor Mucher of Clarostat Mfg. Co., Inc., Dover, N. H.

Wire—R. G. Zender of Lenz Electric Mfg. Co., Chicago, Ill.

Wire Wound Resistor & Rheostat —Roy S. Laird of Ohmite Mfg. Co., Chicago, Ill.

Incidental Radiation Study Planned

AIMED at the establishment of government-industry committees for clarifying problems arising under new rules proposed for incidental radiation devices, the FCC has invited representatives of industry and other interested parties to attend a joint conference at the Commission's Washington offices on November 1, 1949. Of primary importance will be the formation of a group to consider standards and methods for the measurement of electromagnetic noise resulting from the operation of incidental radiation devices—defined by the FCC as those radiating, from a point source, energy incidental to the work to be accomplished, and not necessitating the use of associated receiving equipment.

Also under consideration by the Commission is a proposal to establish joint committees for the study of the following problems: (1) Receiver radiation produced by equipment containing oscillatory circuits. (2) Motors and generators producing radiation. (3) Switches, circuit breakers and other control devices capable of generating r-f signals. (4) Lamps, fluorescent signs and tube-type radiation. (5) Radiation produced by ignition systems. (6) Other types of radiated signals that may be brought to the attention of the conference.

Interested parties are invited to submit to the Commission any suggestions covering the proposed agenda and formation of joint committees.

MEETINGS

OCT. 27-29: Audio Engineering Society's "Audio Fair," Hotel New Yorker, New York City.

OCT. 31-NOV. 2: Second annual Conference on Electronic Instrumentation in Nucleonics and Medicine, Hotel Commodore, New York City.

OCT. 31-NOV. 2: 1949 Radio Fall Meeting of IRE and RMA engineering department, Hotel Syracuse, Syracuse, N. Y.

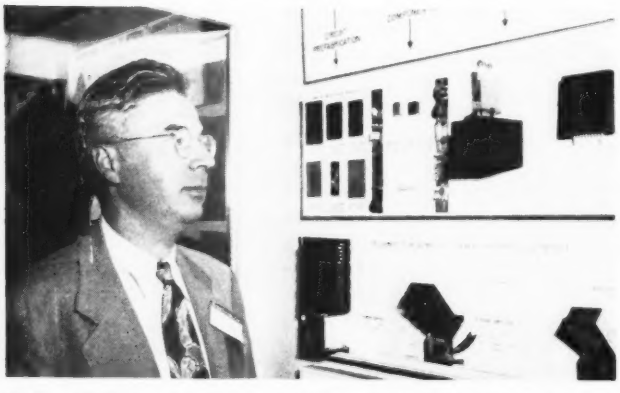
OCT. 31-NOV. 2: Fall Meeting of the URSI and IRE, National Academy of Sciences and State Dept. Bldg., Washington, D. C.

NOV. 14-18: 23rd NEMA Annual Meeting, Haddon Hall Hotel, Atlantic City, N. J.

FEB. 27-MARCH 3: ASTM Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh, Pa.

APRIL 26-28: Fourth annual meeting of the Armed Forces Communications Association, Astoria, New York City, and Fort Monmouth, N. J.

AUTO-SEMBLY TECHNIQUE SHOWN AT NEC



Professor G. H. Fett of the University of Illinois, chairman of this year's National Electronics Conference in Chicago, looks over the Signal Corps exhibit advocating mechanization and potting techniques for some types of military electronics circuitry. Attendance at this year's conference was over 2,000 and practically all exhibit space in the Edgewater Beach Hotel was occupied

IRE Forms New Professional Group

THE INSTITUTE of Radio Engineers has announced the formation of a professional group on quality control. This group has as its major interest quality control of components and entire systems in the fields of radio, communication, television, electronics and allied subjects.

At the administrative committee meeting held in the IRE headquarters, on September 19, 1949, the following officers were elected: chairman—R. F. Rollman of Allen B. DuMont Laboratories, Passaic, N. J.; vice chairman—B. Hecht of International Resistance Co., Philadelphia, Pa.; secretary-treasurer—Victor Wouk of Beta Electric Corp., New York City.

The initial administrative com-

(continued on page 228)

1N34A and 1N58A

SYLVANIA GERMANIUM DIODES

now...

Sealed in Glass!

Smaller, lighter, moisture-proof. Can be mounted side by side without danger of shorting.

Sylvania Electric now offers smaller, lighter germanium diodes hermetically sealed in glass. This construction makes diodes moisture-proof—gives greater electrical stability. And they cost no more than corresponding ceramic types.

These new smaller size glass diodes are ideal for side-by-side mounting—no risk of accidental contact.

Glass types are identified by the suffix "A." Types 1N34A and 1N58A are currently available; other types will be announced from time to time.

Sylvania Electric Products Inc.
Electronics Division, Dept. E-2911
500 Fifth Avenue, New York 18, N. Y.

Please send me information on your new Sealed-in-Glass Germanium Diodes—and also your complete catalog of Sylvania electronic products.

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Industry's

The situation of today's economy which makes it imperative for industry to increase productivity to lower costs opens new opportunities and new markets for industrial applications of electronics.

Industry's need to cut production costs will necessitate increased engineering attention to methods and techniques of mechanization for such routine production processes as sorting, counting, weighing, measuring, controlling, regulating, guarding, inspecting, monitoring, testing and many others.

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Examples of how electronic and allied product manufacturers are selling the cost and productivity advantages offered by their products . . . taken from the latest issue of ELECTRONICS

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Because of electronics' ability to handle routine production processes and many other jobs faster, better and cheaper, lowering costs and increasing productivity, the science of electronics will receive greater attention and new acceptance now. Electronic engineers throughout industry will be asked to find ways of applying electronics to solve plant production problems. They, in turn, will look to ELECTRONICS' editorial and advertising pages, as they have now for almost twenty years, for the technical and product information that will enable them to put productivity up and costs down.

Every manufacturer of electronic or allied products should be sure that these men get that information about his products in ELECTRONICS — factually and completely. Do that and they'll do the selling job – on the inside where it counts.

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It is not just production, control and safety engineers throughout industry who read ELECTRONICS. It's research, design and development engineers of all types too. And they also are concerned with costs — from the point of view of the product itself: its materials, components, subassemblies, housings, bases and mountings, hardware, controls; its simplicity of production and assembly *and* the cost economies it will offer the user.

These men by their buying decisions and specifications are the men who do the buying, if not the actual purchasing, for the entire electronic industry.

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These men can best be reached *and sold* thru the advertising pages of ELECTRONICS with factual information on both the production cost economies and the operating economies your products offer to them and their customers in this all out program of boosting production and lowering costs.

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Shallcross—*the only complete precision resistor line!*

(continued from p 118)

Completely automatic operation has been devised using photocell triggers for the various functions normally performed manually.

A Tunable Built-In TV Antenna

By Robert B. Albright

Engineering Department
Philco Corporation
Philadelphia, Pennsylvania

The announcement, last July, of Philco's new electrically tunable built-in television antenna system came as a surprise to the industry.

Essentially, this built-in aerial consists of a small metal foil antenna, so designed as to receive signals efficiently from all the present 12 vhf television channels, together with a tunable matching circuit that enables the user to tune in each channel precisely for best response

FIG. 1—The Philco built-in television antenna. The dipole is made of 0.005-inch thick aluminum

and to tune out electrical interference.

The development of this electronic built-in aerial system came as the result of several years of research and testing, both in the laboratory and in field locations, of many proposals for a self-contained antenna with good performance. Some of these ideas were technically promising, but proved impractical because of their physical dimensions or cost or they failed to meet production and performance requirements. The goal was a tunable built-in aerial which would approximate the performance of a folded dipole antenna cut to the

New Higher Power Electron Tube with All-Ring Seals

Now Available for Full Power Operation Up to 110 mcs/sec.

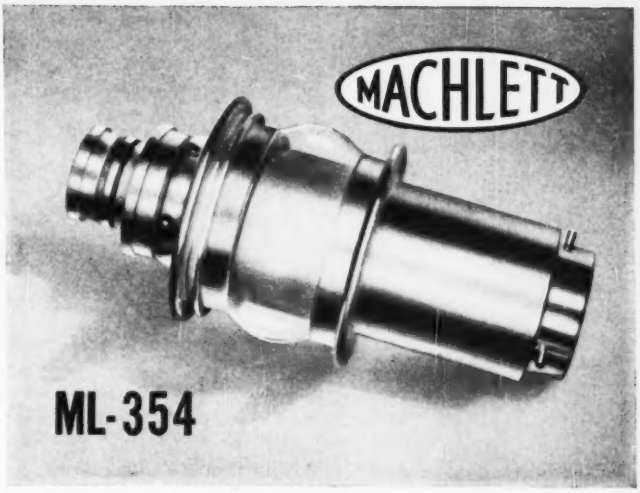
The availability of the Machlett ML-354, a compact, super-power water and forced-air cooled triode for operation up to 110 mcs/sec. in FM, AM, TV and industrial service is a contribution of significant proportion to progress in all fields of electronic development. The tube is provided with coaxial filament, grid, and plate seals, making it ideally suited to cavity-type circuits.

Superior Design Features

Developed to satisfy the need for higher-power electron tubes in broadcast, communications, research, and industrial services, this all-ring-seal triode is of a balanced electrical and mechanical design. Its low plate impedance makes it ideally suitable for broad band applications. All electrodes mount directly from heavy copper cylinders, resulting in a structure which is far superior, electrically and mechanically, to conventional water-cooled electron tube design; all glass-to-metal seals are of Kovar, and the large diameter seals give increased strength and freedom from excessive heating at electrode contacts. The tube incorporates a high-conductivity, heavy-wall copper anode. The integral anode water jacket and quick change water-coupling, contribute to easy and rapid tube replacement. The cathode is a 16 strand self-supporting thoriated-tungsten filament, completely balanced and stress-free throughout life. The rigidly supported grid and cathode are designed to give uniform anode heating. The grid is capable of unusually high heat dissipation contributing to maximum stability of tube performance and circuit operation.

Wide Application

The foregoing design features and characteristics are incorporated in the ML-354 triode, developed by Machlett Laboratories, Inc., Springdale, Conn. The ML-354, having basic design features usable over a wider range of power and frequencies than has been heretofore available in triodes, finds applications, among others, in high-power AM, FM and TV broadcasting, cyclotron and synchrotron oscillators and in induction and dielectric heating.



DESCRIPTION

The **ML-354** is a compact, general purpose, high power electron tube designed for operation at full power up to 110 mcs/sec. It is an all-ring-seal water and forced-air-cooled triode capable of giving in excess of 50 kilowatts output power at 108 mcs/sec. in grounded grid circuits with 10 kilowatts driving power. Considerably higher power is available at lower frequencies. This tube is ideally suited for cavity operation, and its low plate impedance is advantageous for broad band applications. Features include Kovar glass-to-metal seals, sturdy electrode structures, integral anode water jacket, and quick change water coupling. The cathode is a stress-free self-supporting thoriated-tungsten filament.

GENERAL CHARACTERISTICS

Electrical		Mechanical	
Filament Voltage	12.5 volts	Mounting	Vertical, Anode Down
Filament Current	220 amps	Water-flow on Anode	
Amplification Factor	25	for 75 KW Dissipation	45 gpm
Interelectrode Capacitances		for 50 KW Dissipation	30 gpm
Grid-Plate	65 uuf	Air Flow on Seals	
Grid-Filament	83 uuf	to limit glass to 165°C.	220 cfm
Plate-Filament	2.4 uuf	Net Weight, approximate	40 lbs

MAXIMUM RATINGS: Radio-Frequency CW Oscillator

	Max. Freq. 50 mcs/sec.	*Max. Freq. 110 mcs/sec.*	
DC Plate Voltage	15	9	kVdc
DC Plate Current	13	13	Adc
DC Grid Voltage	−1.6	−1.6	kVdc
DC Grid Current	2.5	2.5	Adc
Plate Input	195	100	kW
Plate Dissipation	75	50	kW

For complete technical data on the ML-354 high power, all-ring-seal triode, write to Engineering Department,

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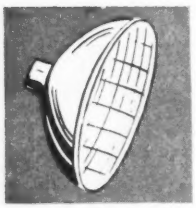

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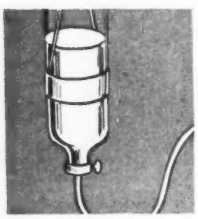
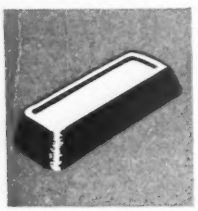


Blood Plasma
— vacuum-dried



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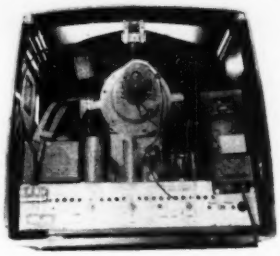

FIG. 2—The aluminum foil antenna follows the contour of the receiver cabinet

correct length for each of the dozen television channels.

Physical Characteristics

As shown in Fig. 1, the built-in aerial has the following parts:

A broad-band antenna which will efficiently receive signals from all the present 12 vhf television channels. This dipole antenna is made of two tapered sections of aluminum foil 0.005 inch thick. Each foil section is about 13 inches long and is folded at the wide end so that, when mounted across the under side of the top rear of the television cabinet, the aluminum foil follows the contours of the cabinet. This folding at the ends of the foil sections also results in the creation of capacity hats, or augmented capacitance between the ends of the dipole. Figure 2 shows how the built-in aerial system is mounted in a typical table model television receiver.

A variable capacitor, part of the matching circuit, is controlled by a tuning knob. The capacitor assembly and tuning control are connected by means of a plastic rod extending to the front of the television cabinet so that it is easy for the user to tune the built-in aerial for any desired channel while watching the picture.

Three loops of wire are included to provide fixed inductances for the matching circuit of the antenna system. The long hairpin loop, marked *A* and *B* on Fig. 3, extends along the rod between the capacitor assembly and the tuning knob, neither of which is shown in this sketch. The two smaller loops or coils, marked *C* on Fig. 3, protrude like ears on either side of the capac-

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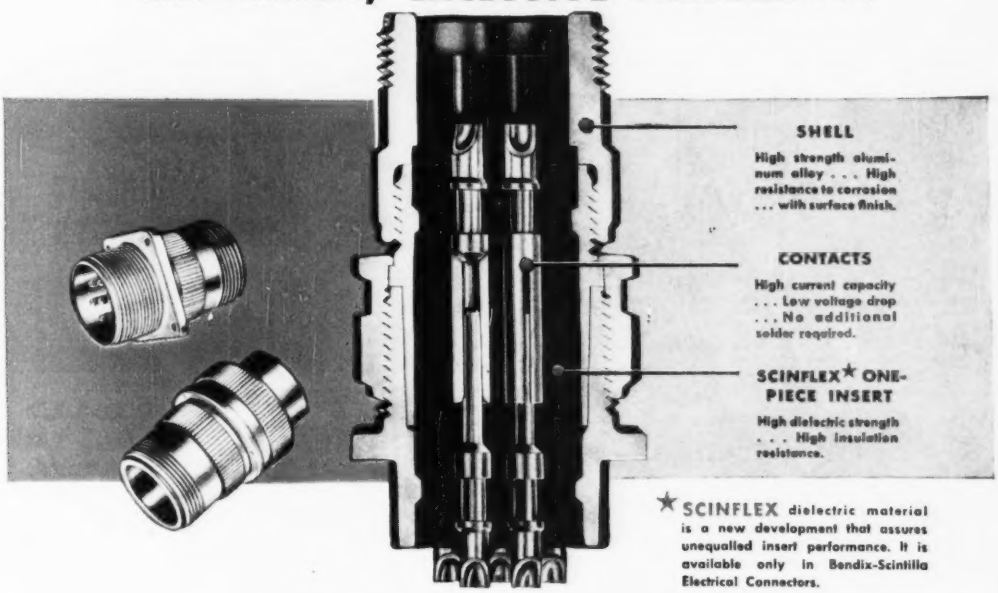
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The accessory STAGE NUMBER 1 adds three functions separately or simultaneously: a) teletype news strip, b) vertical roll strip and c) revolving stage for small objects.

The TELOP, used with TV film cameras, permits instant fading of one object to another, change by lap dissolve or by superimposing. Widest latitude is given program directors for maximum visual interest and increased TV station income.

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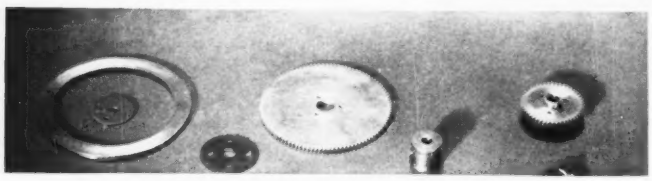

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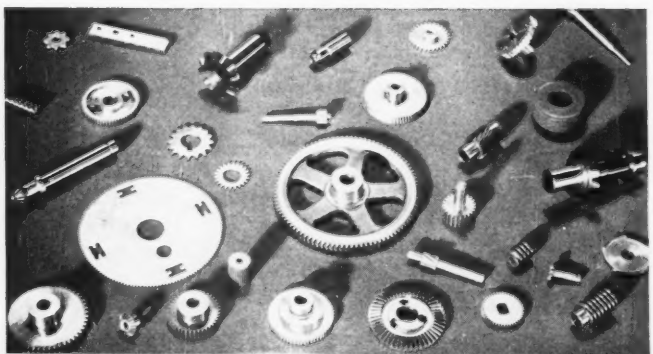

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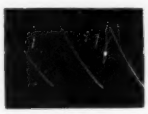
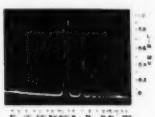


Oscillograph of waveform to be analyzed



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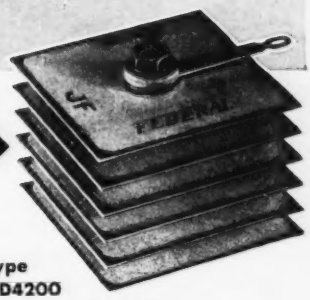

Type 439D4200
D.C. Output—350 Ma.

Now—from the smallest to the largest sets—you can power your *complete* line of television receivers with Federal's weight-saving, money-saving Miniature Selenium Rectifiers.

Federal's line of Miniature Rectifiers... including the latest addition, the 350 ma. model... is *engineered* to meet the power requirements in *all* television receivers—regardless of screen-size or the number of tubes. Two small rectifier stacks, two capacitors and a resistor are all that's required—components that can be mounted anywhere in your chassis and remove *pounds* of useless weight.

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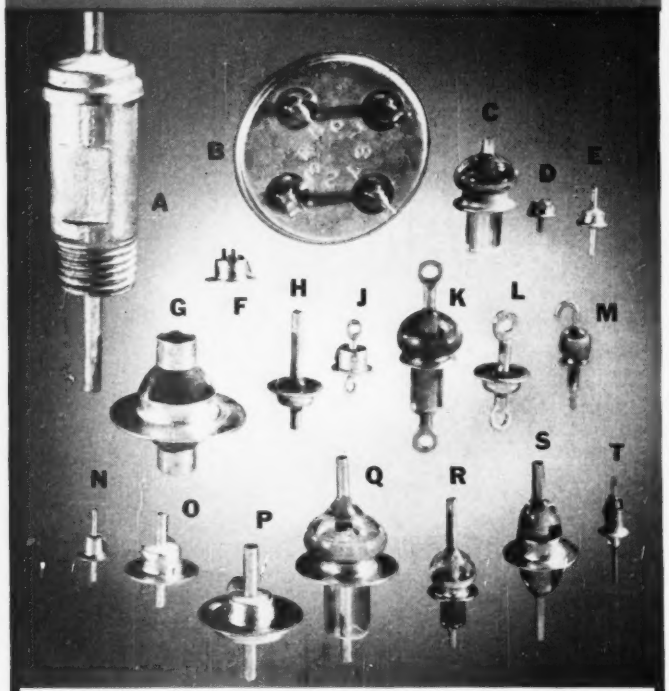
Stupakoff

HERMETIC SEALS



• TYPES AND SIZES TO MEET YOUR NEEDS

Listed below are typical standard sizes of Stupakoff KOVAR-GLASS Terminals. We are equipped to handle orders of any size.

FIGURE	TERMINAL NO.	FLANGE DIAMETER (Inches)	OVERALL LENGTH (Inches)	MAXIMUM AMPERES	MAXIMUM LEAKAGE PATH (Inches)
A	960044	.625	2.500	30.0	.188
B	954004	1.250	.750	15.5	.125
C	952065	.380	.875	12.0	.400
D	952056	.200	.220	4.0	.060
E	950053	.200	.484	5.5	.035
F	955007	.340	.250	4.0	.035
G	952013	.875	.937	75.0	.200
H	952006	.375	.843	12.0	.080
J	951049	.280	.531	10.0	.050
K	951027	.380	1.250	15.5	.400
L	951015	.375	.800	15.5	.090
M	951007	.212	.781	5.5	.312
N	952053	.220	.531	4.0	.060
O	950049	.500	.687	15.5	.080
P	950048	.718	1.000	21.5	.150
Q	950044	.672	1.500	15.5	.550
R	950041	.340	1.125	10.0	.425
S	950022	.500	1.375	15.5	.295
T	950001	.212	.875	5.5	.070

Write for detailed specifications and prices.

STUPAKOFF
CERAMIC & MANUFACTURING CO.
LATROBE, PENNA.

itor assembly of the system.

A short strip of standard 300-ohm twin-conductor line is the connection between the built-in aerial system and the terminals of the high-gain tuner and input circuit of the receiver. This 300-ohm line is tapped off the longer hairpin, at a point where the impedance of the matching circuit is about 300 ohms.

Equivalent Circuit

To understand how the new Philco electronic built-in aerial system works, consider first Fig. 4, which shows the equivalent circuit of the complete system. At the right is the circuit of the dipole antenna, the two aluminum foil sections described above. This circuit includes both the antenna reactance, X_A, and its radiation resistance, R_A. Connected to this antenna circuit is the tunable matching circuit, which

FIG. 3—Simplified sketch of the matching circuit of the built-in television antenna

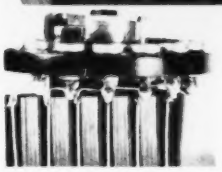
consists of the variable capacitor with reactance X_1, the two smaller side loops with inductive reactances labeled X_2 and X_3 and the long hairpin loop with reactance X_L. The 300-ohm transmission line, which leads to the tuner assembly and is labeled T_L, is tapped off this long loop at the 300-ohm point. This arrangement produces a good match between the foil antenna and the twin-conductor lead-in, and hence a minimum standing-wave ratio.

The built-in aerial system is tuned for each channel to an average impedance of about 1,200 ohms. Over the low band the radiation resistance of the antenna is fairly uniform and low in value, while the antenna's reactance is capacitive. Hence to bring this antenna circuit to resonance the matching circuit must be inductive. The relatively large inductance of the longer loop is the main factor in achieving this, whereas the effect of the smaller loops on this band is of lesser importance. The variable tuning capacitor essentially serves to vary

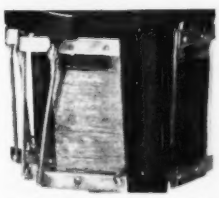
Quadruple-leaf, phosphor-bronze switches with wiping contact. Contact surfaces ground flat. Contact resistance only 0.002 to 0.003 ohm. Cam-type positive detent mechanism. Entire unit shielded behind aluminum panel.

PRECISION RESISTANCE BOXES

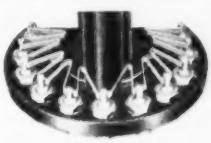
● The General Radio Type 602 Decade Resistance Boxes are universally accepted as the adjustable standard of resistance. Designed primarily for direct-current and audio-frequency use, they can be used as well into the low radio-frequency range.



Aryton-Perry windings on the 1-, 10-, and 100-ohm decades on molded phenolic cards especially shaped and heat treated to minimize aging effects.



Unifilar ribbon windings on the 1,000- and 10,000-ohm decades on mica cards.



Bifilar construction of the 0.1-ohm units.

FEATURES

● **ACCURATE ADJUSTMENT** — all units are adjusted within 0.1% of engraved values, except the 1-ohm cards are within 0.25% and the 0.1-ohm units within 1%.

● **LOW ZERO RESISTANCE** — less than 0.003 ohm per decade.

● **LOW TEMPERATURE COEFFICIENT** — less than ±0.002% per deg. C. at room temperatures, except the 0.1-ohm decade is slightly higher.

● **LOW RESIDUAL INDUCTANCE AND CAPACITANCE** — in all decades through the 100-ohm steps no serious frequency error below 500 kc.

● **THOROUGH AGING** — each resistor aged at temperature of 135 deg. C., reducing subsequent drifting to a negligible amount.

● **LOW THERMAL EMF EFFECTS** — through use of manganin, Evanohm or Karma wire.

● **SCALE VALUES OVERLAP** — each decade has 11 contact studs and 10 resistance units.

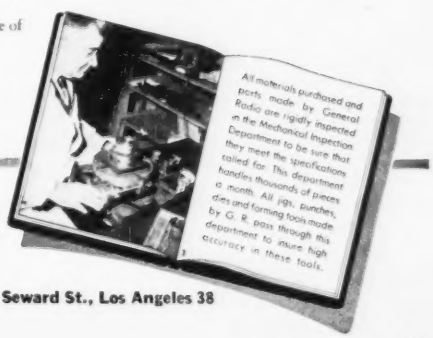
● **POSITIVE DETENT MECHANISM** — switches can be adjusted without looking at panel engraving.

● **ENGRAVED CARRYING CAPACITY** — current ratings of each decade engraved on panel.

● **THOROUGH SHIELDING** — decades mounted on aluminum panel inside copper-lined walnut cabinet.

● **EIGHT SIZES** — between 0.1 to 11 ohms (in steps of 0.1 ohm) and 1.0 to 111,110 ohms (in steps of 1.0 ohm).

● **MODERATELY PRICED** — $32.00 to $90.00



All materials purchased and parts made by General Radio are rigidly inspected in the Mechanical Inspection Department to be sure that they meet the specifications called for. This department handles thousands of pieces a month. All jigs, punches, dies and forming tools made by G. R. pass through this department to insure high accuracy in these tools.

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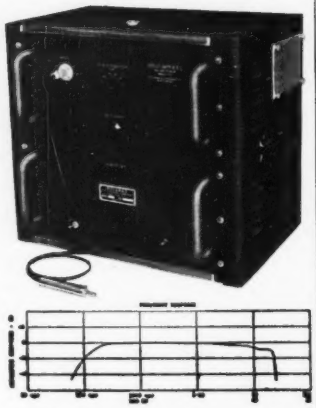
20 MC VIDEO AMPLIFIER

Model V



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- Gain of 50 db.
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Input Impedance: Probe—12 mmf + 470,000 ohms; Jack—30mmf + 470,000 ohms; Output Impedance 18mmf + 470,000 ohms each side push pull; Max. Input Volts 500 peak to peak with probe; Max. Output Volts 120 volts peak to peak (push pull); Power: 115 volts 50/60 cps AC Line; Size 19¼"x22"x14¾".

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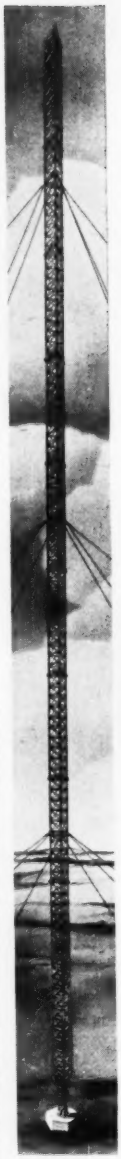

Truscon equips world's tallest radio tower *with*

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This new 1220-foot Truscon Radio Tower, tallest ground-supported tower ever built, incorporates many advanced engineering specifications. But one important specification remains unchanged . . . the use of PALNUT Self-Locking Nuts . . . continuing a 15-year standardization by the Truscon Steel Company, Youngstown, Ohio for all its towers.

- **Prevents loosening of regular nut and bolt.**
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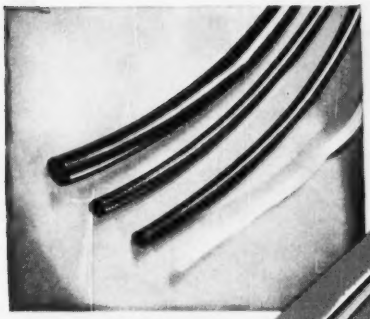

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the inductive reactance of the long loop to match the antenna's capacitive reactance over the five low-band channels.

On the high band, the reactance of the antenna becomes inductive, and the radiation resistance of the antenna is higher. Here the circuit is tuned to resonance again by means of the variable capacitor; but the inductance of the two smaller loops is a substantial factor.

Smith Chart

Computations involving the electrical behavior of this Philco built-in aerial system are simplified if use is made of the Smith chart shown in Fig. 5.

For example, take 85 mc, the center frequency of television channel 6 and study the response of the aerial system at this frequency. The long line on Fig. 5 shows the curve for the system if we consider only the dipole foil antenna, which is satisfactory over the low band

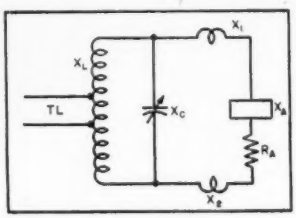
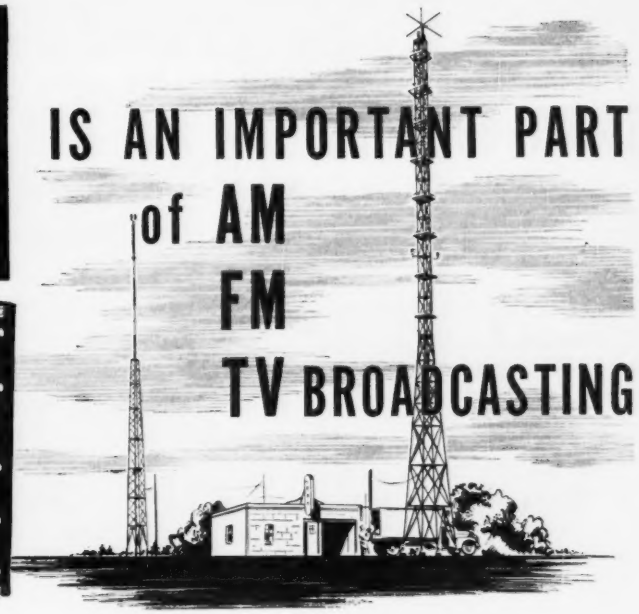


FIG. 4—Equivalent circuit of the television antenna

(center frequencies from 57 to 85 mc) because the equivalent resistance, R_{eq}, of the foil antenna is sufficiently high by itself to permit good matching to the 300-ohm transmission line. However, at high-band frequencies (177 to 213 mc center frequency) we have previously noted that the two smaller loops with fixed inductances become important additions to the reactance of the antenna to bring R_{eq} up to values comparable to the low-band equivalent resistances. Hence the Smith curve must be moved to the right as indicated on Fig. 5.

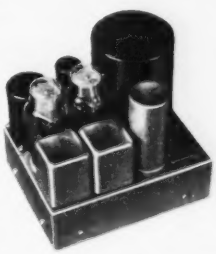
Now, using the Smith chart and selecting the values for R_A, the radiation resistance, and X_A, the reactance of the antenna, from the chart, we can readily

EM IS AN IMPORTANT PART of AM FM TV BROADCASTING



STABILINE Automatic Voltage Regulators Type EM (Electromechanical) are the answer to regulation problems in radio and television transmitting stations . . . high frequency relay stations.

The FCC recommends adequate voltage regulation equipment where the power supplied by the utility varies more than 3% from nominal over a 24 hour period. The STABILINE Voltage Regulator Type EM is ideally suited for this regulation task. Some of the outstanding features include . . . zero waveform distortion, complete insensitivity to the magnitude and power factor of the load, no effect on system power factor, high efficiency and no critical adjustments. Its long-term stability for 24 hour line correction means that Type EM requires negligible attention. Under normal conditions, the output voltage need not be adjusted more than once a month.



The STABILINE Voltage Regulator Type EM consists of an electronic detector circuit controlling a motor-driven POWERSTAT variable transformer. The moving parts are rugged, quality manufactured components which require a minimum of service and attention. The electronic control circuit itself is plug-in type and incorporates the latest advances in detector circuit design. This plug-in feature, combined with the convenient replacement service agreement made at the time of purchase, eliminates maintenance difficulties. The attractive black wrinkle-finished front panel has a 4 inch output voltmeter and screw driver adjustment controls for sensitivity and output voltage setting. Numerous models are available in ratings from 1 KVA to 100 KVA to meet most requirements. Rely on the experience of the Superior Electric Company's staff of voltage control engineers to assist with your voltage regulation problems.

Request Bulletin 448 for detailed information on the STABILINE Type EM and its application in the broadcast field.

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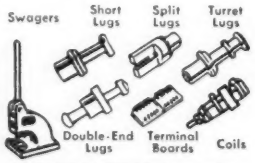

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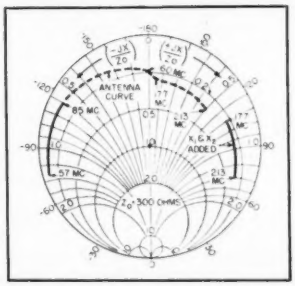

FIG. 5—Smith chart of built-in television antenna simplifies computation of electrical behavior

make the following computations: $R_{eq} = R_4 + X_4^2/R_4 = 1{,}200$ ohms (at 85 mc) R_{eq} is then matched to the 300-ohm line by tapping the fixed hairpin loop at the 300-ohm point.

The voltage gain of the built-in system (at 85 mc) is $(R_L/R_4)^{\frac{1}{2}}$ or $(300/30)^{\frac{1}{2}} = 3.3$.

Performance and Life Tests

Tests have proved that the built-in aerial system is a good approximation of the results one could obtain by using 12 separate folded dipoles, one for each channel. Field engineering tests in four metropolitan areas, New York, Philadelphia, Chicago and Washington, indicated that, in the presence of a fair-to-strong signal, the reception from the built-in aerial system was often superior to that with the outdoor antenna. The reason is that using the tunable matching circuit of the built-in system, a better match was obtained on each channel and it was possible to tune out interference from f-m stations and other electrical noise.

In residential districts around Manhattan, including Queens, Flushing, Brooklyn, The Bronx, northern New Jersey and commuting areas of Long Island and Westchester County, good picture and sound quality was obtained from practically all stations in all locations.

It should be mentioned, however, that where the signal is weak, in so-called fringe areas, an outdoor antenna may be necessary. In such cases, the built-in aerial system is disconnected by the removal of its

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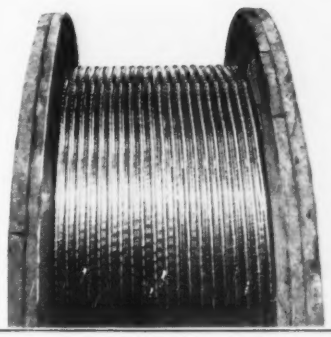

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In addition to these valuable physical characteristics, "326" Monel is a thoroughly *practical* metal . . . economical to buy; easy to use; readily workable.

"326" Monel can be welded, brazed, or soldered . . . can be readily machined, formed, drawn, or forged. It is available in standard mill forms.

Next time you are faced with a problem that demands a tough, non-magnetic, corrosion-resistant alloy . . . specify "326" Monel.

Meanwhile, write for your copy of "*Inco Nickel Alloys for Electronic Uses.*" This valuable 26-page booklet gives the composition, characteristics, and typical applications of 18 helpful Inco Nickel Alloys.

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"326" Monel
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Fe	2.50 max.
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C	.30 max.
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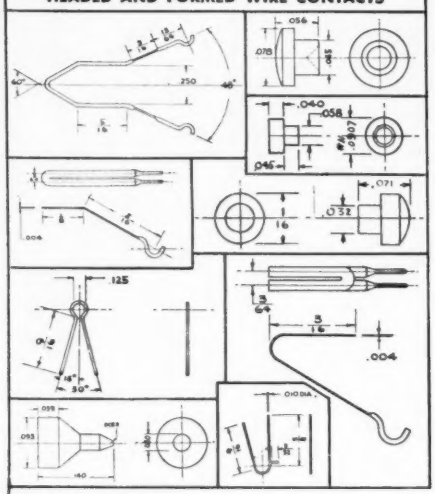

YET these are "STANDARD" NEY PRECIOUS METAL COMPONENTS

Chart shows form and overall dimensions of a few of the many types of contacts made from Ney Precious Metal Alloys for brush or wiping contact applications. Full technical and test data are available on request. Other Ney Precious Metal Alloys have solved many special industrial application problems. Consult us freely without obligation.

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LOW ATTEN. TYPES	IMPED. OHMS	ATTEN. db/100 ft at 100 Mc/s	LOADING Kw at 100 Mc/s	O.D"
A.1	74	1.7	0.11	0.36
A.2	74	1.3	0.24	0.44
A.34	73	0.6	1.5	0.85

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C.1	7.3	150	2.5	0.36
PC.1	10.2	132	3.1	0.36
C.11	6.3	173	3.2	0.36
C.2	6.3	171	2.15	0.44
C.22	5.5	184	2.8	0.44
C.3	5.4	197	1.9	0.64
C.33	4.8	220	2.4	0.64
C.44	4.1	252	2.1	1.03

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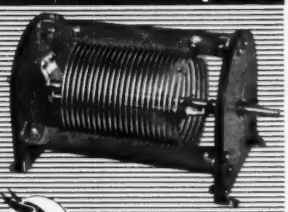

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For high power application. Roller contact type. Approximate maximum inductance 75 uh with 3.8" tubing, 50 uh with 1.2" tubing. Cast aluminum end frames.

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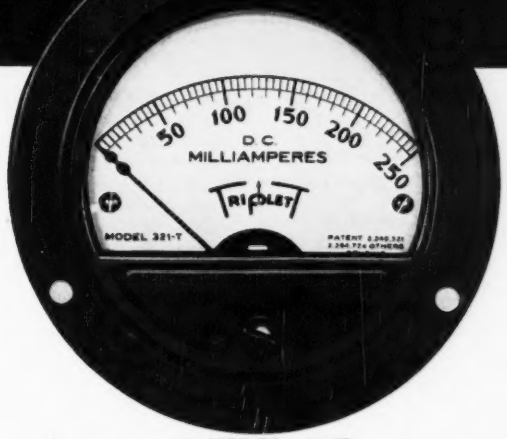

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REGULATED WITHIN ½% 200 to 450 VOLTS . . .

For both load variation from 0 to 200 milliamperes and input variation from 105 to 125 volts.

Output D.C. voltage variation is within 0.5 volts between 200 and 450 volts for load variations from 0 to 200 MA.

. . . for industrial and research use

- RIPPLE VOLTAGE: Less than 5 millivolts.
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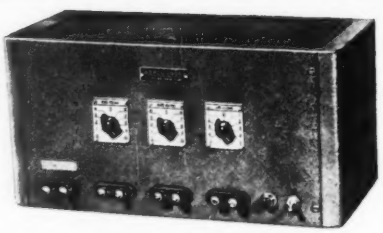

- Two continuously variable B supplies, from 0 to 300 volts at currents up to 150 ma. Ripple less than 10 millivolts.
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- One heater supply, 6.3 volts at 5 amperes.
- Power requirements: 105 to 125 volts, 50 to 60 cycles.
- B voltages are varied by new Kepco "Electronic Voltage Divider."

KEPCO "Electronic Voltage Divider" eliminates use of heavy duty wire wound potential dividers . . . B voltage regulation characteristics are superior to standard designs . . . complete voltage control from front panel . . . all connections to sturdy front panel binding posts . . . voltages isolated from chassis.

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Kepco ELECTRONIC INSTRUMENTS

300-ohm transmission line from the antenna terminals and the substitution of the lead-in from the outside antenna.

Applying the Infrared Image Converter Tube

By R. D. WASHBURNE
Telemarine Communications Co.
New York, New York

THE infrared image converter tube, some types of which are now becoming available in quantity at low cost, was designed as a military weapon for seeing in the dark. The complete American equipment versions were known as the Snooperscope and Sniperscope. The former is a small-arms attachment for night-time sniping and the latter was used for short-range reconnaissance over wider areas. The appearance of a British version, type CRI-143, is shown in Fig. 1. It was used in the equipment dubbed Tabby.

The British service tube presents the advantage of simplicity. An example of its use is shown in Fig. 2. This model was built at N. Y. State College of Ceramics at Alfred, N. Y., under the direction of L. B. Bassett, Professor of Ceramic Engineering, for research in infrared microscopy. General details of this type unit are shown in Fig. 3A.

Experimental Design

There are at least three ways in which the infrared image converter tube may accomplish its fundamental purpose of converting invisible radiations into visible ones, namely, through the use of: (1) a uniform field between cathode and anode.

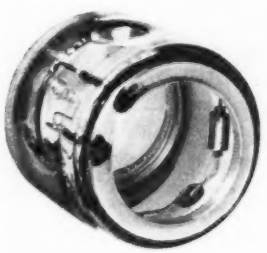


FIG. 1—British type CRI-143 infrared image converter

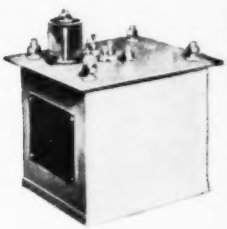
a complete line of

hermetically sealed oil-filled

HIGH-VOLTAGE COMPONENTS

Rectifiers

Small, lightweight a-c to d-c power supply units for use with cathode-ray tubes, television camera tubes and radar indicator scopes, electron microscopes, and similar jobs. Typical outputs are 7, 9 and 13 kv. Low regulation—the 7-kv unit illustrated does not exceed 3.5% regulation per 0.1 milliampere load, holds ripple on output voltage to less than 1%. Size, only 6" x 6" x 7"; weight 8 lb.



Pulse Transformers

Pulse transformers for use with either hard-tube or line-type modulators. Available in voltage ratings of 10 kv or above. These units are ideal for radar applications, stepping up or down, impedance matching, phase reversing and plate-current measurements. Also suitable for nuclear physics research work, television and numerous special applications in and out of the communications fields.

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Resonant-charging reactors, accurately designed and constructed for radar service. Usually required in ratings of 40 kv and below, 1 ampere and below and 300 henries and below. Higher ratings are being built, and can be considered. When required, small- and medium-size designs can be provided with 3 to 1 range of inductance adjustment.

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Filament transformers available with or without tube socket mounted integral with the high-voltage terminal. Low capacitance. Ratings to match any tubes; insulated to practically any required level.

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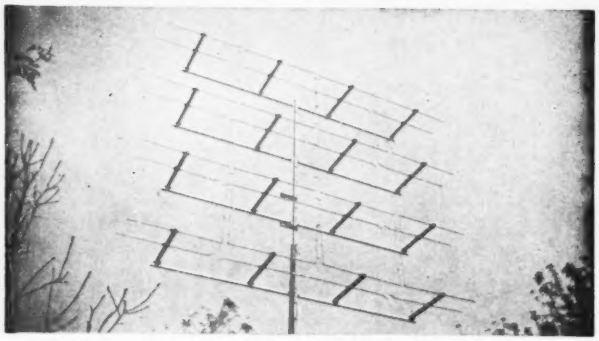

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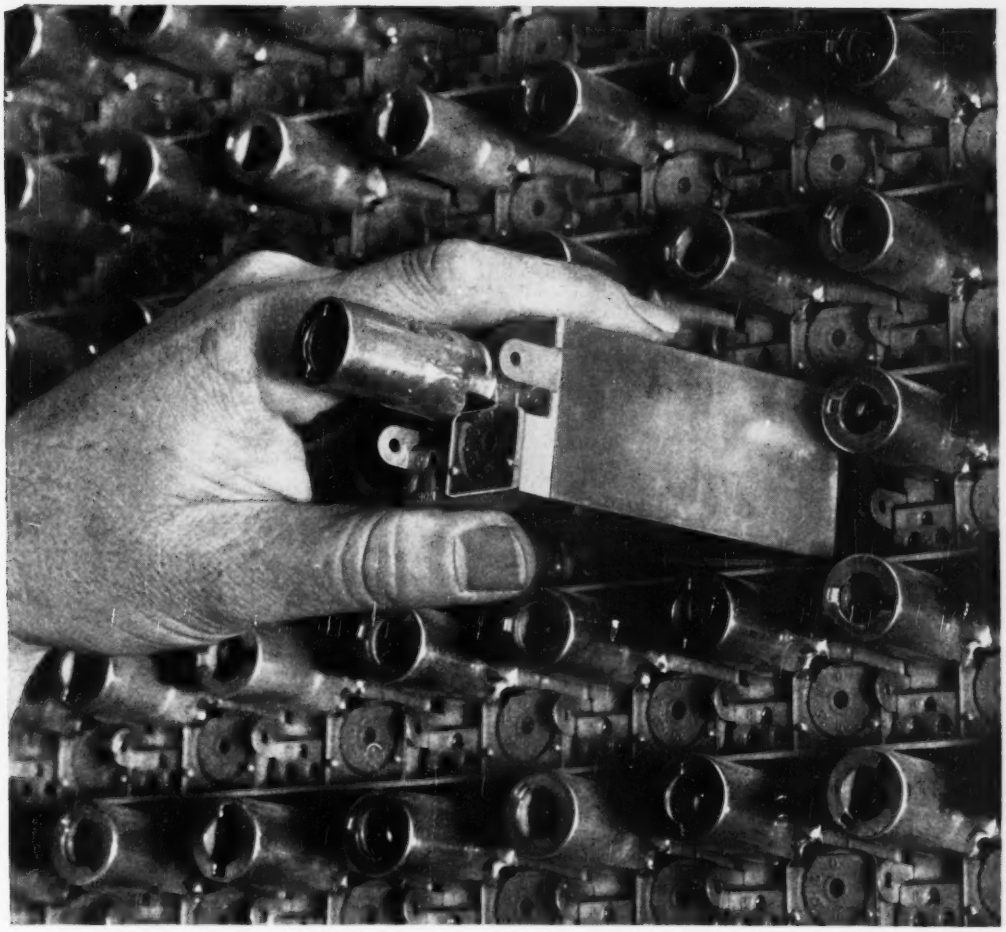

ANOTHER SCORE IN THE

battle of the inches

It takes many costly buildings to house your telephone system. Every inch saved helps keep down the cost of telephone service. So at Bell Telephone Laboratories engineers work constantly to squeeze the *size* out of telephone equipment.

In the picture a new voice frequency amplifier is being slipped into position. Featuring a Western Electric miniature vacuum tube, tiny permalloy transformers, and special assembly techniques, it is scarcely larger than a single vacuum tube used to be. Yet it is able to boost a voice by 35 decibels. Mounted in a bay only two feet wide and 11½ feet high, 600 of the new amplifiers do work which once required a *room* full of equipment.

This kind of size reduction throughout the System means that more parts can be housed in a given space. Telephone buildings and other installations keep on giving more service for their size — and keep down costs.

The new amplifiers, which will soon be used by the thousands throughout the Bell System to keep telephone voices up to strength, are but one example of this important phase of Laboratories' work.

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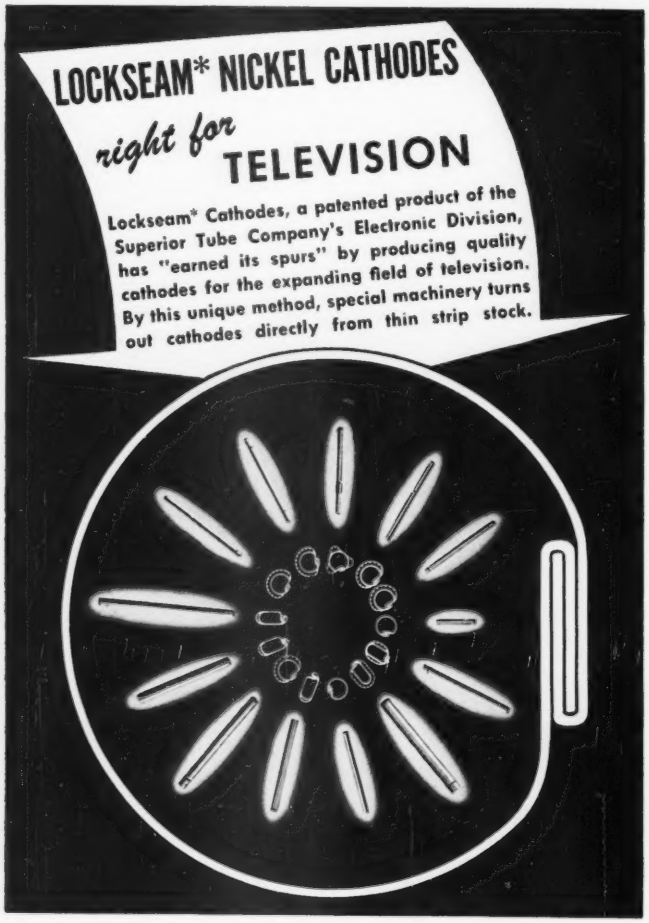

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Superior Lockseam* cathodes are available in round, oval and rectangular shapes, plain or beaded as required.

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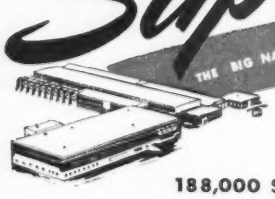

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188,000 SQ. FT. PRODUCING METAL TUBING

(2) a magnetic lens, or (3) an electrostatic lens.

The first method is incorporated in the British tube, while the second system was never utilized because of factors of size, weight and complexity, the third was the one accepted for the American tube, which carried the designation 1P25; however, few reached the surplus market.

In tubes using the first method, the conversion of invisible light into visible is achieved without turning the image upside down. In tubes of the third however, the principle of the electrostatic lens is employed, with the result that the image is inverted on the viewing screen.

There is available at comparatively low cost however, an f/2.1 object lens assembly made by Bausch & Lomb for use with the 1P25 or the CRI-143. Its focal

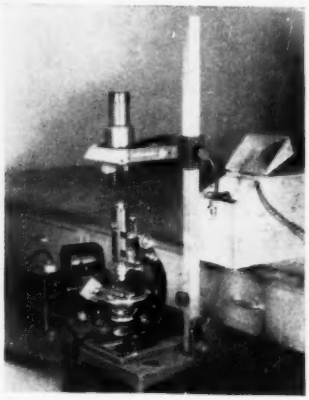


FIG. 2 — Infrared converted unit is mounted above laboratory miscroscope

length is 3.5 inches. This lens unit projects a sharp, inverted and reversed image on the infrared image converter tube. More exactly, it focuses an image on the photocathode, whereupon electrons are released and, due to an applied d-c voltage, bombard the screen, causing it to fluoresce in proportion to the amount of invisible light on the cathode.

Incidentally, artificial light reduces the efficiency of infrared equipment in proportion to the intensity of the light (an analogy is the use of a flashlight in a lighted

51V-1 glideslope receiver, covers in place

Glideslope Receiver

51V-1

...inside and out

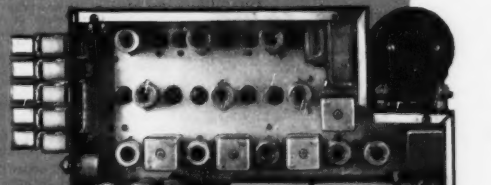
THIS is the new Collins 51V-1 glideslope receiver for aircraft. Note the orderly design, and the accessibility of all tubes, components, and wiring.

The 51V-1 provides reception of 90/150 cps tone modulated glideslope signals on any of the twenty channels in the uhf range of 329-335 mc. This receiver together with Collins 51R navigation equipment will fulfill ILS receiving requirements for military, commercial and private aircraft. The design of the 51V-1 is based on "Glideslope Receiver Characteristics" issued by Aeronautical Radio, Inc., and on U. S. Airforce specifications.

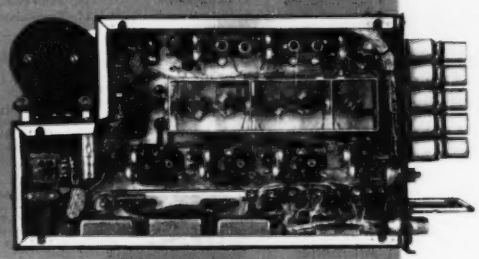
Output circuits of the 51V-1 receiver feed standard ID-48ARN deviation indicators including flag alarm. By means of the flag alarm the pilot has a positive indication of the reliability of the glideslope signals and instrumentation.

The 51V-1 control circuits are integrated with the standardized R/θ channeling system with channel selection provided by means of a Collins 314U remote control unit.

More complete information, in the form of an illustrated bulletin, is yours on request.



Collins 51V-1 chassis (right side)



Collins 51V-1 chassis (left side)

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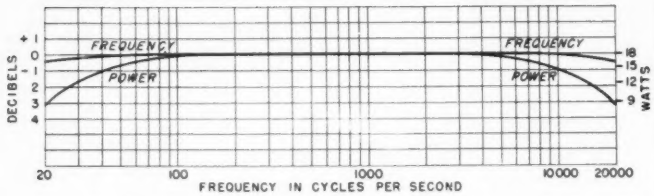

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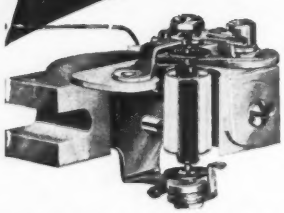

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OSCILLOSYNCHROSCOPE
MODEL OL-15B

Combining the functions of

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SYNCHROSCOPE

An outstandingly versatile instrument applicable to—

TELEVISION
FACSIMILE
PULSE MODULATION
RADAR
NUCLEAR PHYSICS
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GENERAL FEATURES

Five-inch cathode ray tube operating at 4,000 volts accelerating potential. Ordinarily supplied with P1 phosphor, others available on special order. Vertical amplifier flat within 3 db. from 5 cycles to 6 megacycles. One inch deflection with .05-volt RMS input. Horizontal amplifier flat within 1 db. from 5 cycles to 1 megacycle. Built-in calibrating system for determining wave amplitude. No external meter needed. Deflection plates and intensity grid available directly at front panel terminals. No waiting for trace to reappear after adjusting gain or applying DC component to input. Low capacitance, high impedance probe supplied for minimizing test circuit disturbance. Reasonably symmetrical waves permit full screen vertical deflection. Contained in single cabinet, weighs less than 100 pounds.

AS AN OSCILLOSCOPE

Linear sawtooth sweeps continuously variable from 5 to 500,000 per second in conjunction with the excellent vertical amplifier outlined. Permits observation of RF waves and envelopes to above 6 megacycles. Because of the extended ranges of the amplifiers and sweep generator, oscilloscopic capabilities are correspondingly increased over standard oscilloscopes.

AS A SYNCHROSCOPE

An internal trigger generator continuously variable from 200 to 5,000 cycles can be used to excite external equipment as well as the sweeps. The trigger can be made by panel control to lead or lag the start of the sweep by amounts up to 1,000 microseconds, making it possible to phase any part of a pulse or transient onto the screen for measurement. Sweep speeds of 1/4, 1/2, 1, 5, 20, and 200 microseconds per inch provide convenient image time expansion for detailed observation. As the sweep generator will sweep once for each incoming pulse, single transients or pulses occurring at irregular intervals can be observed or photographed.

For More Detailed Information Write for Descriptive Bulletin MO-4911

— • COMPANION INSTRUMENTS • —

SWEEP CALIBRATOR MODEL GL-22A

For accurately calibrating sweeps. Markers are provided at 1/10, 1/2, 1, 10, and 100 microsecond intervals which may be applied as deflection or as intensity modulation. May be triggered directly from OL-15B. Write for bulletin MC-4911.

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For permanent records of waveform on 35mm. film. Single frames or variable continuous motion permit recording of all phenomena. Various lenses, magazines, etc. available. Easily set up with OL-15B. Write for bulletin MF-4911.

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room), and therefore, visibility improves as the viewer's eyes become dark adapted.

Where the object lens is used with the CRI-143 tube, a second such lens system, or one of the lower-cost equivalents now available, may be needed as an ocular to re-invert the image on the viewing screen to right-side-up, unless the usage of the equipment is such that the aspect of the image is immaterial, as in photography. Such erecting lenses may be of spectacle quality.

The British tube operates from a much simpler d-c power supply than is required by the American type. As. Fig. 4 shows, a source delivering only a single voltage is all that is required to energize the CRI-143. The current drawn by this tube is infinitesimal, being of the order of 10^{-6} ampere.

Principle of Operation

Referring to Fig. 4, the CRI-143 is seen to comprise two parallel plates—a cathode and an anode—spaced about 5 millimeters (approx. 3/16 inch), placed at one end and within an evacuated Pyrex glass tube with flat ends.

The cathode is made by deposit-

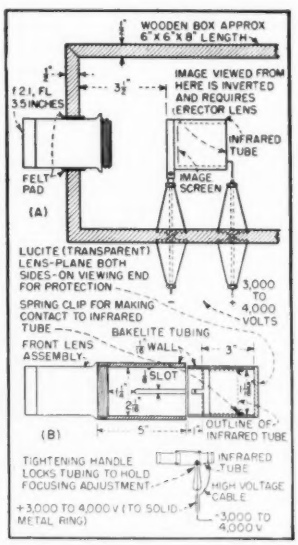
WOODEN BOX APPROX 6"X6"X8" LENGTH
IMAGE VIEWED FROM HERE IS INVERTED AND REQUIRES ERECTOR LENS
f:1, FL 3.5 INCHES
INFRARED TUBE
IMAGE SCREEN
FELT PAD
(A)
LUCITE (TRANSPARENT) LENS-PLANE BOTH SIDES-ON VIEWING END FOR PROTECTION
3,000 TO 4,000 VOLTS
SPRING CLIP FOR MAKING CONTACT TO INFRARED TUBE
BAKELITE TUBING
FRONT LENS ASSEMBLY
WALL
SLOT
OUTLINE OF INFRARED TUBE
(B)
TIGHTENING HANDLE LOCKS TUBING TO HOLD FOCUSING ADJUSTMENT
INFRARED TUBE
HIGH VOLTAGE CABLE
+3,000 TO 4,000 V (TO SOLID METAL RING)
-3,000 TO 4,000 V

FIG. 3—Experimental laboratory (A) and portable (B) models of infrared image converter tubes

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Your Special Problems

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#46 COSMALITE is designed for application where punching and stapling qualities are important. It is especially adaptable for threading or other requirements.

#SLF COSMALITE is designed for thin wall applications such as permeability tuners. It has unusual strength and excellent electrical properties.

#96 COSMALITE is the standard for all radio and television applications. It possesses excellent electrical and mechanical qualities and meets coil form requirements with high electrical strength and minimum surface leakage.

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#102 MODIFIED COSMALITE retains the excellent electrical properties of #102 along with the mechanical and versatile advantages of #96 COSMALITE. Designed especially for high voltage applications where staples or rivets are fastened on coil forms.

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Whether your product needs protection and isolation from outside vibratory forces or control of vibration created by its own movements Lord engineers can help you.

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LORD MANUFACTURING CO., ERIE, PA.

Canadian Representative: Railway & Power Engineering Corp., Ltd.

LORD Vibration Control Systems

ing on the inside surface of one end face of the tube an infrared-sensitive layer of silver-caesium oxide so microscopically thin it is virtually transparent. A graphite ring on the outside periphery of the tube affords connection with this photocathode when the tube is placed in its metallic mounting. The photoemissive sensitivity of the cathode is out to about 1.3 microns.

The anode is a layer of medium-persistence Willemite deposited on a glass plate thin as a calling card, and supported from a metallic contact ring at the opposite or clear-glass end of the tube. It is through this end that the screen is viewed. When a positive voltage is applied to the anode of the tube, this screen glows green, and if a properly illuminated scene is sharply focused on the cathode, there appears clearly on the anode in shades of green an image with a definition of up to 350 lines per inch (almost photographic quality). Increasing the voltage from about 3,000 to about 5,000 volts increases the brilliance of the image.

Illumination and Filtering

Invisible light in the infrared region may activate this image converter tube either directly or by reflection. The illumination may be an infrared point source, as would be the case for a beacon or flashlight with the visible rays of the lamp filtered out; or, it may be the result of variations in infrared reflectivity in the original scene as illuminated by infrared rays.

An ordinary tungsten lamp may be used with its visible rays screened to near or below the visual threshold by a Wratten (Eastman Kodak) 87 or 88 filter. It is sometimes advisable to use another such filter in the objective system to reduce the effects of stray illumination, such as moonlight.

An infrared filter may be made by cementing dyed cellophane to clear glass. Nickel oxide glass (Corex red-purple, obtainable from Corning Glass Co.) is opaque to visible rays and transparent to infrared radiations. Another filter is an opaque solution of iodine in carbon disulfide or alcohol; use with caution as both solutions catch fire

Long Life...

UNDER SEVERE CONDITIONS

Three years ago Sangamo successfully pioneered the FIRST molded tubular capacitor. The experience gained in these three years is now applied by new effective manufacturing methods, and proven by special exhaustive tests which invariably exceed the requirements of actual service conditions. Thus, the Type 30 you purchase today offers positive promise of exceptional long life under severe conditions.

85° C Performance: Excellent. Trouble-free long-life operation in spite of the high temperatures encountered in auto radios, television receivers, or any other application where high temperatures cause trouble.

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Immersion Resistance: Excellent. Far surpasses any existing specification requirements. Insulation resistance not impaired.

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Remember this about Sangamo Type 30 Tubulars: They are molded at *low* pressure. This means their elements are undamaged in fabrication. It also means longer life, greater dependability, and the absence of "hot spots." A trial of Sangamo Molded Tubulars will convince you!

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SPRINGFIELD · ILLINOIS
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SC4911

GIVES YOU TWICE AS MUCH POWER GAIN PER DOLLAR!

NEW *Andrew* MULTI-V FM ANTENNA

TYPE	NO. OF BAYS	POWER GAIN	PRICE
1308	8	7.3	$2800
1304	4	3.7	850
1302	2	1.6	320

This table shows you why the new Andrew Multi-V is your best FM antenna buy!

NOW! Minimize your investment in equipment. Get top performance for only half the cost. The new Andrew Multi-V FM antenna is made and guaranteed by the World's Largest Antenna Equipment Specialists. It's another Andrew "First."

FEATURES

★ **Twice as much power gain per dollar as any other FM transmitting antenna!**

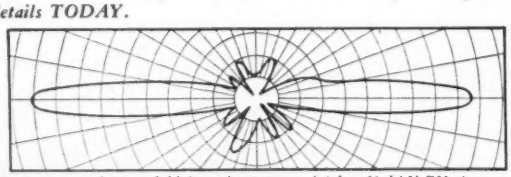
★ Top performance, yet half the cost of competitive antennas.

★ Side mounting construction permits installation on towers too light to support heavier antennas.

★ Circular radiation pattern.

★ Factory tuned to required frequency — no further adjustments necessary.

It will pay you *to use the Andrew Multi-V Antenna on your FM station. Write for Bulletins 86 and 186 for complete details TODAY.*



Typical vertical plane field intensity pattern of 4 bay Multi-V FM Antenna.

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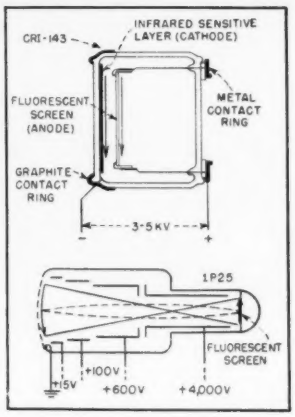

FIG. 4—Diagrammatic representation of electrostatic lens and uniform field types of converter tubes

easily, and therefore, must be kept in closed containers.

Experimental setups may use a General Electric sealed-beam lamp delivering up to 80,000 or 100,000 maximum beam candlepower over a 12 to 15 deg angle; the infrared filter may be one of the Polaroid XRX series, or Corning heat-transmitting glass. Another light source may be the GE Reflector Infrared Heat lamp, or the Mazda Purple-X lamp.

Of passing interest is the fact that when an infrared light is shone at about right-angles to the line-of-sight of a viewer, objects or persons hidden in brush appear brighter against a darker background, and hence, cross-illumination may at times be desirable. Movement of foliage or brush is easily detected in this manner.

Construction

Details for making an inexpensive, experimental unit are shown in Fig. 3A. This is more in the nature of a lab model, a more portable version being given in Fig. 3B.

Connection to the cathode end of the image converter tube is best made by means of a clamping ring, as the element terminal is only graphite. Connection to the opposite end is easily accomplished by the use of a contact spring; or, a lead or mounting bus may be soldered to the solid metallic ring on the tube, using care to prevent the heat of

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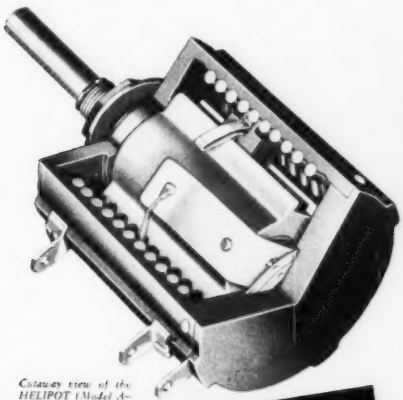

Cutaway view of the HELIPOT (Model A-10 Turn—1¼" Diameter)

THE BECKMAN Helipot

(Trademark of the HELical POTentiometer)

Provides *many times* greater resistance control in *same* panel space as conventional potentiometers!

IF YOU are designing or manufacturing *any type* of precision electronic equipment be sure to investigate the greater convenience, utility, range and compactness that can be incorporated into your equipment by using the revolutionary HELIPOT for rheostat-potentiometer control applications . . . and by using the new DUODIAL turns-indicating knob described at right.

Briefly, here is the HELIPOT principle . . . whereas a conventional potentiometer consists of a *single* coil of resistance winding, the HELIPOT has a resistance element *many times* longer coiled *helically* into a case which requires no more panel space than the conventional unit. A simple, foolproof guide controls the slider contact so that it follows the helical path of the resistance winding from end to end as a single knob is rotated. Result... *with no increase in panel space requirements*, the HELIPOT gives you as much as 12 times* the control surface. You get far greater accuracy, finer settings, increased range—with maximum compactness and operating simplicity!

COMPLETE RANGE OF TYPES AND SIZES

The HELIPOT is available in a complete range of types and sizes to meet a wide variety of control applications . . .

MODEL A: *5 watts, 10 turns, 46" slide wire length, 1¾" case dia., resistances 10 to 50,000 ohms, 3600° rotation.*

MODEL B: *10 watts, 15 turns, 140" slide wire length, 3¼" case dia., resistances 50 to 200,000 ohms, 5400° rotation.*

MODEL C: *3 watts, 3 turns, 13⅛" slide wire length, 1¾" case dia., resistances 5 to 15,000 ohms, 1080° rotation.*

MODEL D: *15 watts, 25 turns, 234" slide wire length, 3¼ case dia., resistances 100 to 300,000 ohms, 9000° rotation.*

MODEL E: *20 watts, 40 turns, 373" slide wire length, 3¼" case dia., resistances 150 to 500,000 ohms, 14,400° rotation.*

Also, the HELIPOT is available in various special designs . . . with double shaft extensions, in multiple assemblies, integral dual units, etc.

Let us study *your* potentiometer problems and suggest how the HELIPOT can be used—possibly is already being used by others *in* your industry—to increase the accuracy, convenience and simplicity of modern electronic equipment. No obligation, of course. Write today outlining your problem.

**Data for Model A, 1¼" dia. Helipot. Other models give even greater control ranges in 3" case diameters.*

THE BECKMAN Duodial

The inner, or Primary dial of the DUODIAL *shows exact angular position of shaft during each revolution. The outer, or Secondary dial shows number of complete revolutions made by the Primary dial.*

A multi-turn rotational-indicating knob dial for use with the HELIPOT and other multiple turn devices.

THE DUODIAL is a unique advancement in knob dial design. It consists essentially of a primary knob dial geared to a concentric turns-indicating secondary dial—and the entire unit is so compact it requires only a 2" diameter panel space!

The DUODIAL is so designed that—as the primary dial rotates through each complete revolution—the secondary dial moves one division on its scale. Thus, the secondary dial counts the number of complete revolutions made by the primary dial. When used with the HELIPOT, the DUODIAL registers *both* the angular position of the slider contact on any given helix as well as the particular helix on which the slider is positioned.

Besides its use on the HELIPOT, the DUODIAL is readily adaptable to other helically wound devices as well as so many conventional gear-driven controls where extra dial length is desired without wasting panel space. It is compact, simple and rugged. It contains only two moving parts, both made entirely of metal. It cannot be damaged through jamming of the driven unit, or by forcing beyond any mechanical stop. It is not subject to error from backlash of internal gears.

TWO SIZES—MANY RATIOS

The DUODIAL is now available in two types—the Model "R" (illustrated above) which is 2" in diameter, and the new Model "W" which is 4¼" in diameter and is ideal for main control applications. Standard turns-ratios include 10:1, 15:1, 25:1 and 40:1 (ratio between primary and secondary dials). Other ratios can be provided on special order. The 10:1 ratio DUODIAL can be readily employed with devices operating *fewer* than 10 revolutions and is recommended for the ¾-turn HELIPOT. In all types, the primary dial and shaft operate with a 1:1 ratio, and all types mount directly on a ¼" round shaft.

Send for this HELIPOT AND DUODIAL CATALOG!

Contains complete data, construction details, etc., on the many sizes and types of HELIPOTS . . . and on the many unique features of the DUODIAL. Send for your free copy today!

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the soldering iron from cracking the glass tube.

Power Supply

Any power supply capable of delivering the required voltages may be used. Even a toy ignition transformer of good construction, such as those sold by hobby shops for model airplanes and automobiles, will deliver sufficient voltage and current.

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Robot Race Starter

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Battery-operated electronic race starter

At the press of a button a bell starts ringing for a nine-second period. This bell sends the participants to their starting positions

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For many years the manufacture of transformers was controlled by individual manufacturer's ingenuity and ability together with his customer's desires and requirements. Inevitably there were as many different constructions and variations for any one type of transformer as there were manufacturers and customers. Each design duplicated the function of another and yet, no two were physically interchangeable.

This became most obvious at the beginning of the last war for each branch of the government services had its own specification for components-transformers as well as all other electronic components.

Development of new equipment, production on existing designs, and replacement of parts for existing equipment all presented their own problems when it came to duplication and interchange of supplies. Standardization was *imperative!*

How JAN?

Therefore, the Standards Agency was established by the Armed Forces to correlate manufacturing procedures and devise one best design for a particular job—satisfactory to all military arms, readily available and always interchangeable.

Transformers created a much greater problem than other components due to the many styles and variations in existence, nevertheless standard specifications for the various components, including transformers, were devised by the Standards Agency thru study, development and constant testing.

Thru extensive research in new products and methods, we, at Kenyon, are able to produce high quality transformers, in accordance with the JAN Specification for transformers, namely JAN-T-27.

If you have any questions on JAN Transformers, do not hesitate to call upon Kenyon's engineering staff.

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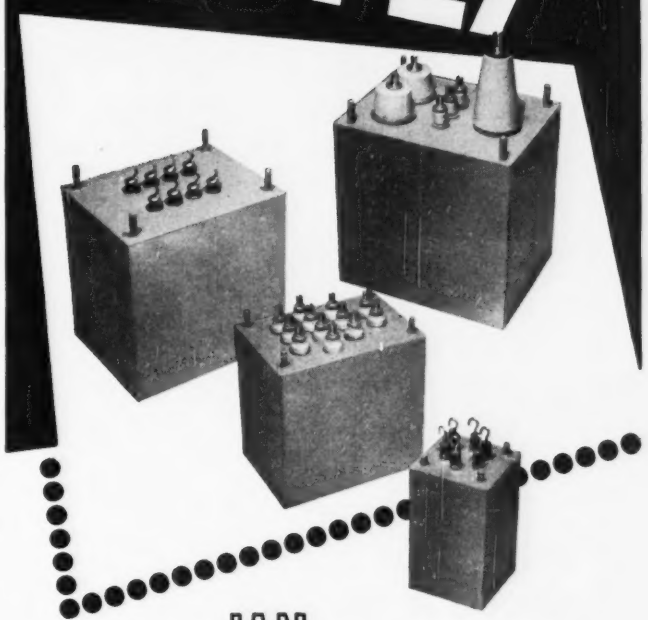

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Now — KENYON gives you the complete story on JAN. Since the inception of Joint Army and Navy specifications, KENYON has built JAN-type transformers for leading manufacturers throughout the country.

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MODEL S20X
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On every count the new Turner Model 20X has won the vote of users. Response to voice and music pickups is smooth and even over a desired range of frequencies. Output level is remarkably high. Engineered for dependable service indoors or out with high quality moisture sealed crystal circuit. Light in weight, natural to hold, and most convenient to use. It is equipped with hook ring for hanging. Attractive case is finished in rich baked brown enamel. And the price, complete with 7 ft. cable is exceptionally low.

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on the cinder path. The next sound they hear is a buzzer which continues for 2.3 seconds and warns the runners to get set. A blank cartridge is then fired signaling the runners to start. If any of the runners jumps the gun, as can be detected if the phototube light beam is interrupted before the gun shot, a loud bell rings, signifying a false start.

Shown in the starting position is Bob Nield, a Danville, Illinois, high school student whose 22.5-second 220 has been checked by the electronic system.

Power Tubes in Parallel at UHF

By J. R. Day
Radio Engineering Labs.
Long Island City, N. Y.

Current interest in television and other communications methods at uhf centers about the problem of obtaining appreciable power output from conventional equipment. The aural transmitter furnished for an experimental television system operating in the frequency range from 500 to 550 mc employs six type 2C39 tubes, air-cooled, with a power output of 100 watts. In addition, the output stage acts as a tripler.

The arrangement illustrated is the simplest and most straightforward way found to parallel uhf tubes for increasing power capabilities. Possible means were limited by the requirements that n times the power of 1 tube be secured with n tubes, and that the arrangement have substantially the same upper

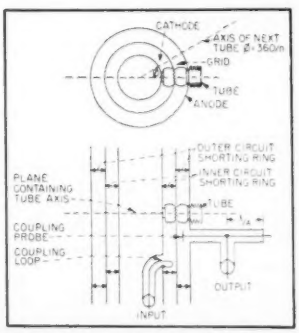
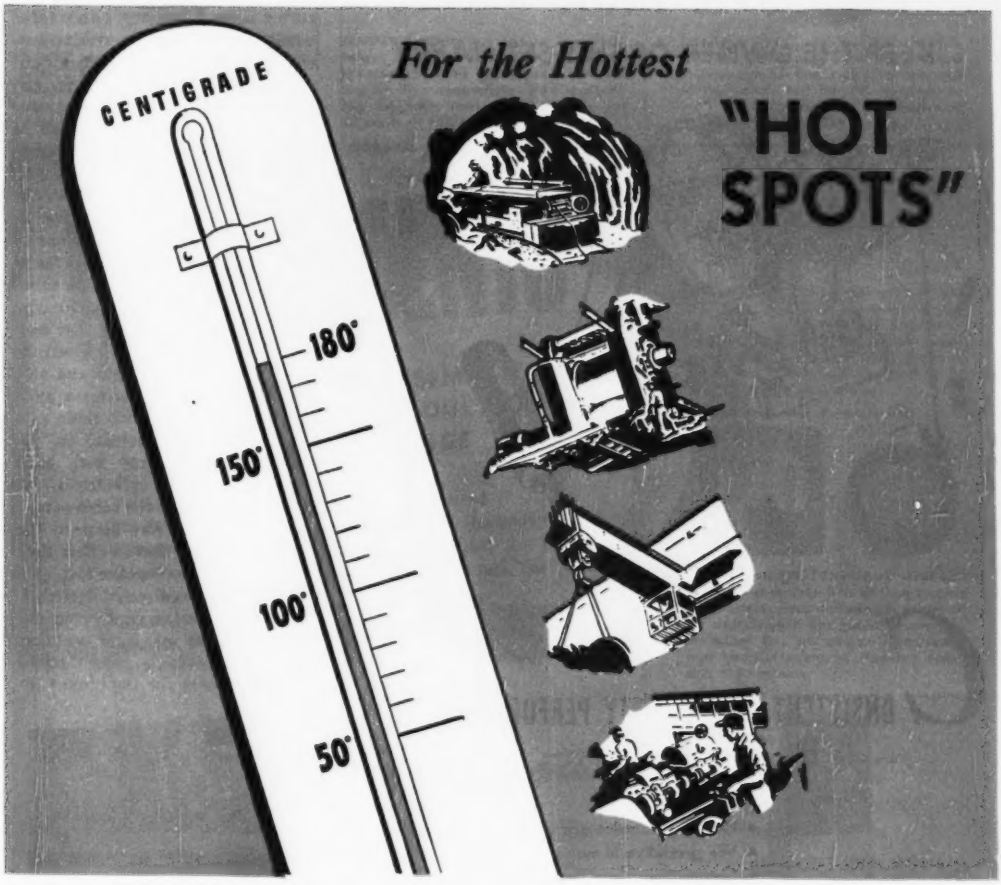


FIG. 1—Cross sections of a cylindrical multitude amplifier operated above 500 mc

A MAGNET WIRE



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The answer is in war-developed *silicones*, now brought to the magnet wire field by Anaconda in amazing glass insulated Silotex–bonded with *silicone varnish*. Such insulation qualifies for the new A. I. E. E. high-temperature rating of "Class H"... 180°... a 140° rise in temperature over an ambient 40° C!

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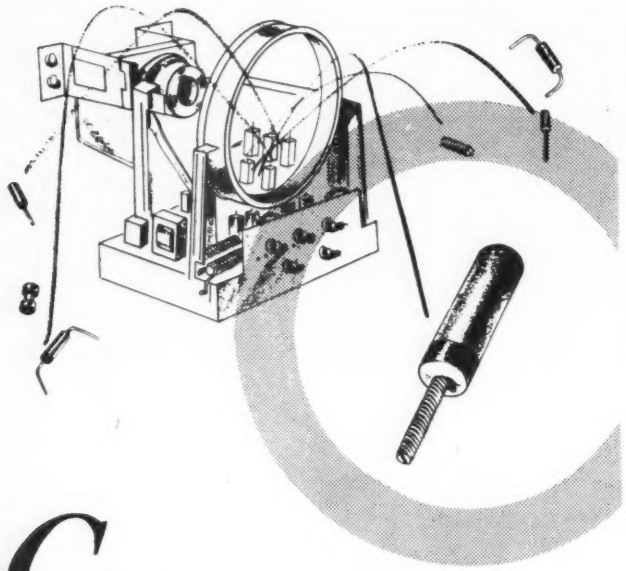

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frequency limit as an optimum design for a single tube. These two requirements are related in that in undesirable designs failure to secure n times the power with n tubes usually is due to a progressive lowering of the upper frequency limit as n increases. The present circuit meets these requirements for all practical values of n, and is amenable to use with currently available tube types.

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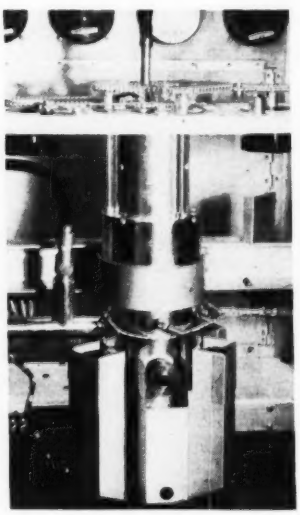

FIG. 2—Inner and outer shorting rings for tuning cavities are actuated by chain and sprocket drive. Rectangular ducts are for air cooling

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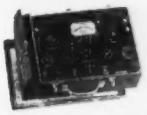

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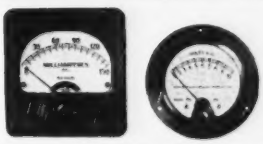

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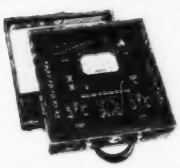

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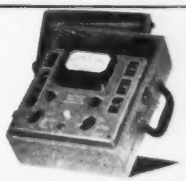

(Model 769) ELECTRONIC ANALYZER incorporating a conventional Volt-Ohm-Milliammeter with self-contained power source—a high-impedance electronic Volt-Ohmmeter using 115 volt, 60 cycle power—a stable, probe-type, Vacuum Tube Voltmeter, for use to 300 megacycles.

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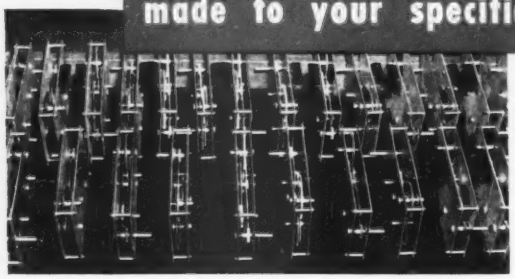

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volved. The tubes are oriented, to facilitate insertion, so that the smallest electrode connection is inward. Thus with 2C43's the outer circuit would be the grid-cathode, while with 2C39's it would be the plate-grid circuit.

The possibility that this type of circuit could support extraneous modes was examined. Neither paper work nor experiment disclosed any unusually favorable conditions for such modes. Of the second order possibilities the most likely seemed to be the one wherein the electric field is normal to the cylindrical surfaces and varies in intensity along a path in a plane normal to the axis of the cylinders. Such a mode could always be suppressed by means of a slot parallel to the cylinder axis. Removal of tubes did not cause excitation of spurious modes.

Other Possibilities

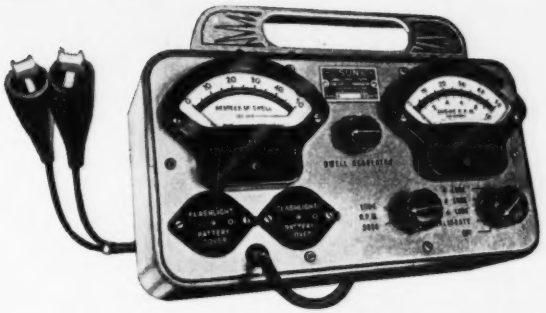
A rectangular cross-section with the tubes located in opposite sides appeared of interest in the case where the tubes are required to be operated with their axis in a vertical position.

The usual means of coupling energy into and out of these circuits are applicable, and include probes, loops and slots.

Figure 2 shows a power tripler employing this arrangement, and for operation from 500 to 550 megacycles. Six type 2C39 triodes are used, spaced at 60-degree intervals around a 6-inch outer cylinder. The aluminum ducts leading to the tubes are for the small amount of anode cooling air required. Operating conditions for this unit are: power output, 100 watts; plate input, 300 watts at 800 volts; driving power, 80 watts, at 1/3 plate-circuit frequency.

In the particular unit shown the input circuit (the inner one), operating in the order of 175 megacycles, was in the form of a loaded quarter-wave coaxial, the center cylinder being ended at the cathode connections, and the grid cylinder being sealed off by a disc an inch or so away. This tripler is used in a television aural transmitter, which is direct crystal-controlled and is excited by a serrasoid frequency modulator.

A BRADLEY CASE HISTORY



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Sun Electric Corporation's Dwell-Tach Unit aids garage mechanics to diagnose the condition and spacing of distributor breaker points while the engine is operating. Bradley vacuum-processed copper oxide rectifiers (Coprox C014D) are used as a basic component in the dwell circuit.

The function of the rectifier is to maintain balance in a bridge type circuit as the voltage across a pair of connected test leads is varied from 4 to 15 volts DC. This feature permits the instrument to be used for automobiles having either 6 or 12 volt systems. In addition, each section of the rectifier serves to alternately block and pass voltage pulses from the distributor points as they open and close, thus enabling the actual dwell angle to be read on a meter.

Sun reports that "the field performance of the Bradley copper oxide rectifier has been excellent and no difficulty has been experienced due to cell breakdown . . . The Bradley rectifier was selected because of the consistent characteristics obtainable and because of low temperature-resistance changes in forward and inverse resistance values."

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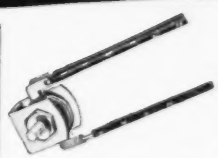

COPROX C014D

SPECIFICATION DATA

These control and test equipment rectifiers are rated from 20 milliamperes half-wave to 35 milliamperes full wave, up to 50 volts maximum peak inverse. Supplied with 3" flexible leads. Housing size ½" x ½" x ⅜". Mounts on single 6-32 screw, ⅜".

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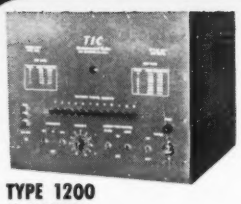

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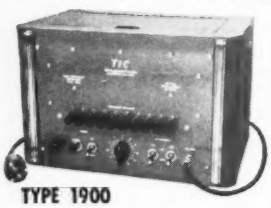

TYPE 1900
CRYSTAL CONTROLLED
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A 10 frequency, 400 cps. modulated crystal controlled oscillator, ideal for production line adjustment of stagger tuned I.F. amplifiers. Available with crystals ranging from 4.5 to 40 M.C. Output frequency accurate to 0.02%. Immediate push button selection of frequency. Output attenuator range .5V to 500 microvolts. Self contained regulated power supply.

TYPE 1500
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(continued from p 122)

this means that it enables existing television sets to receive color programs in monochrome without any modification whatever and without any converter or adapter. To receive the color transmissions in color, existing black-and-white sets can use a color adapter.

Studio Equipment

A block diagram of the broadcasting station for this RCA color system is shown in Fig. 1. The color camera, related equipment and synchronizing generator are the same as for the RCA wide-band simultaneous system announced in 1946. This studio apparatus provides three signals, one for each of the primary colors (green, red and blue). Each of these signals may contain frequency components out to a maximum of 4 mc and an average or d-c component.

For one signal routing of Fig. 1, each color signal passes through a low-pass filter which eliminates frequency components above 2 mc. The three resulting low-frequency signals, G_L, R_L, and B_L, are then sent into an electronic commutator or sampler, where each color signal is sampled for a very short time, so that each color is sampled 3,800,000 times per second.

The sampling pulse generator is an integral part of the electronic commutator and makes use of the trailing edge of the horizontal synchronizing pulse to time the sampling of each of the color signals.

The sampler output signals are combined electronically in Adder No. 1. Standard synchronizing signals from the synchronizing generator are also applied at this point.

The principle of mixed highs is also utilized. For the second signal routing of Fig. 1, the three color signals from the camera are combined in electronic Adder 2 and then are passed through a band-pass filter. The mixed-highs output M_H of this filter contains frequencies between 2 and 4 mc, with contributions from each of the three color channels. The mixed-high frequencies are fed to Adder 1 which is already receiving the signals from the sampler and from the synchronizing generator.

The sampler output, the mixed highs and the synchronizing pulses

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With a power output of 15 watts, the new Bendix-Pacific 421250 Transmitter and 421230 Amplifier combination has a line of sight range of up to 100 miles.

The new 421250 Transmitter has been developed to supplement a complete line of telemetering components designed for use in the Bendix-Pacific FM/FM subminiature telemetering system, having a nominal power output of 2 watts. This unit is capable of withstanding extreme vibration and shock and still operate precisely to give indications for the most exacting measurements. The total weight, including the case, is only .845 pounds and it measures 2" diameter by 5⅛" long.

The 421250 Transmitter can be tuned over the frequency range of 215 mc to 230 mc and is adaptable for use with current fed or voltage fed antenna systems. It has a line of sight range of up to 40 miles and may be used to drive the 421230 Power Amplifier.

The Bendix-Pacific 421230 Telemetering R. F. Amplifier has a nominal power output of 15 watts which provides adequate power for line of sight ranges of 40 to 100 miles. The tuning range matches that of the 421250 Transmitter. The total weight, including the case, is only 1.75 pounds.

The two transmitting units described above exemplify the building block method of telemetering system assemblies. Through the use of standard Bendix-Pacific components, the purchaser can readily assemble an instrumentation system exactly suited to his specific needs —thus effecting the utmost economy in volume, weight and cost.

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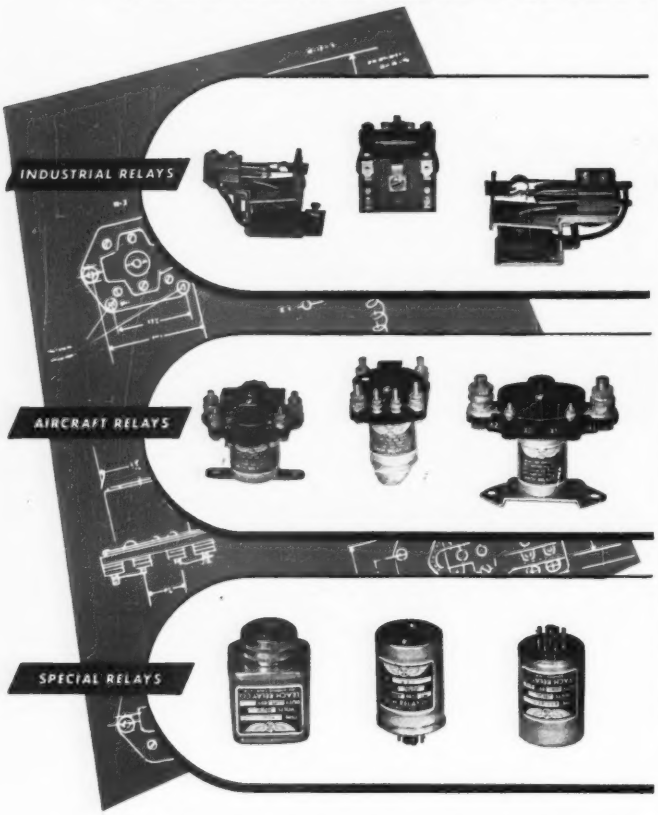

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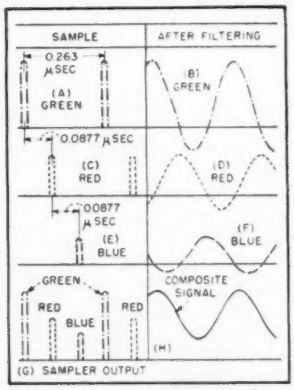

FIG. 2—Color sampling sequence for a large polychromatic area

combined by Adder 1, go to a low-pass filter which cuts off at 4 mc. The signal from this filter is applied to the modulator of a conventional vhf or uhf television transmitter. No change in the normal transmitter equipment is required.

Color Sampling Details

The functioning of the electronic sampler is shown in Fig. 2 for large uniform polychromatic areas, with the three primary colors represented by three different signal strengths. Each channel signal is sampled every 0.263 microsecond ($0.263 = 1/3.8$), with the channels staggered 0.0877 microsecond as shown. The composite output of the sampler (Fig. 2G) feeds into the low-pass filter. Since only large-area color is under consideration, the mixed-highs signal need not be included.

The narrow green pulses of Fig. 2A, occurring at a rate of 3.8×10^6 pulses per second, are smoothed by the low-pass filter to give the wave of Fig. 2B consisting of a d-c component which is the average of the pulse sample, plus a sine wave which has a frequency of 3.8 megacycles (the filter having removed the higher order harmonics). The 3.8-megacycle sine wave and the d-c component change together, as the green signal changes in strength, in such a way that the signal of Fig. 2B always passes through zero at the same interval of time after the peak regardless of the strength of

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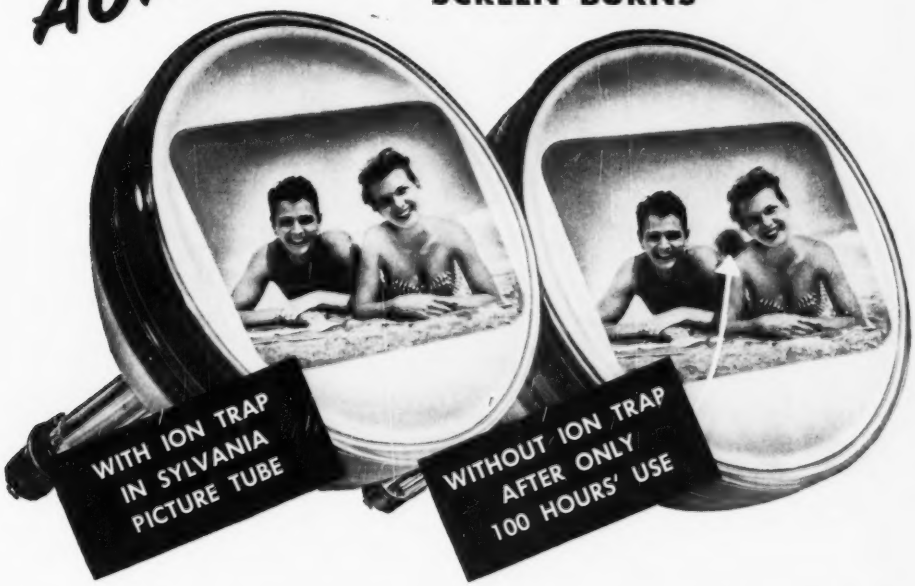

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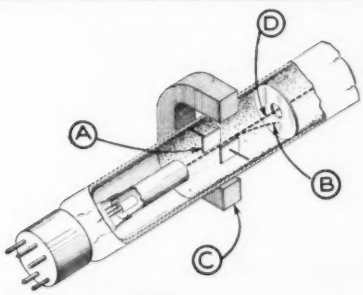

- **A.** Electrostatic field
- **B.** Ions are bent away from normal axis of tube by electrostatic field
- **C.** External magnet neutralizes the effect of the electrostatic field on the electrons
- **D.** Electrons follow a straight line

Heavy ions are thus trapped in the electron gun while the electrons pass through to strike the fluorescent screen.

Owners of television sets equipped with Sylvania Television Picture Tubes report their screens still bright and unblemished after more than 1000 hours' use. Much credit for this top quality performance belongs to Sylvania scientists who hold the basic patents on the magic "ion trap." With this device these scientists prevented destruction of the fluorescent screen by heavy ion bombardment. So successful is this ion trap that now many other major TV tube makers are using it under agreements with Sylvania.

These same Sylvania Television Tube scientists are now developing shorter large-screen picture tubes and special tubes for uhf television. Their continued research makes the Sylvania label your guarantee of the newest and finest in television picture tubes. Sylvania has a complete line of all-glass and glass-metal types for television and general purpose cathode ray applications. They are available now from your Sylvania Distributor.

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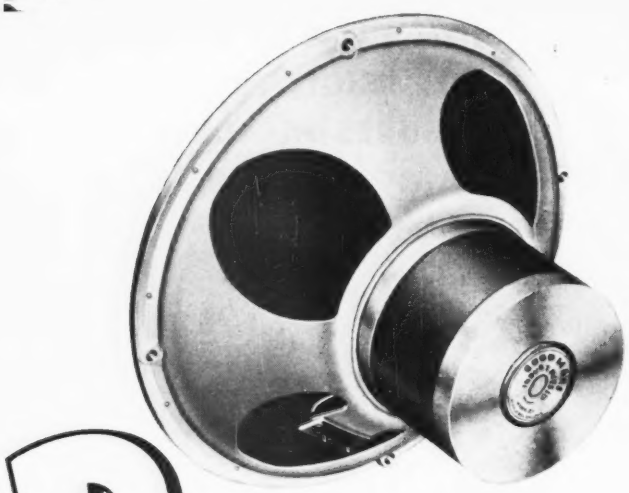

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Overall Diameter	12.5/16"
Overall Depth	7"
Fundamental Resonance	75 c.p.s.
Voice Coil Impedance	15 ohms at 400 c.p.s.
Maximum Power Capacity	20 watts Peak A/C
Total Flux	195000 Lines
Nett Weight	18 lbs. 4 ozs.

R22/1206/15

Overall Diameter	12.5/16"
Overall Depth	7"
Fundamental Resonance	55 c.p.s.
Voice Coil Impedance	15 ohms at 400 c.p.s.
Maximum Power Capacity	20 watts Peak A/C
Total Flux	195000 Lines
Nett Weight	18 lbs. 4 ozs.

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the green signal. Red and blue samples are similarly smoothed.

When any one color signal out of the filter reaches its maximum value, the other two responses are crossing the zero axis.

While the curves have been shown separately for illustrative purposes, it should be remembered that the pulse train of Fig. 2G goes into the low-pass filter. Thus the composite signal of Fig. 2H comes out of the smoothing filter. This is applied to the modulator of the transmitter.

The action of the system in the presence of a varying color is illustrated in Fig. 3. The sampling pulses as they come out of the sampler are indicated by vertical lines in Fig. 3A. Figure 3B indicates the result of smoothing in the filter. This envelope may also be regarded as the envelope of the transmitted radio-frequency signal, neglecting the contribution of the mixed-highs signal.

It has been demonstrated that the mixed-highs procedure is successful and satisfactory in a wide-band simultaneous system. In the RCA color television system the sampling process by itself is sufficient to carry high-frequency components of each color signal so that when combined the resulting bandwidth is below 4 mc (the sampling frequency determines the highest frequency which will be passed). However, the choice has been made

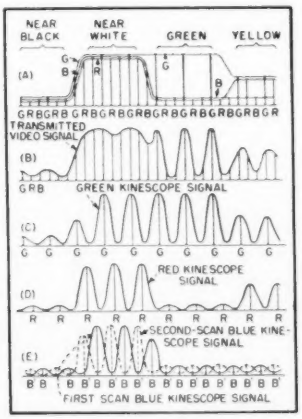
NEAR BLACK
NEAR WHITE
GREEN
YELLOW
(A)
G B R G B
G B
G
B
G R B G R B G R B G R B G R B G R B G R B G R B G R
TRANSMITTED VIDEO SIGNAL
(B)
G R B
GREEN KINESCOPE SIGNAL
(C)
G G G G G G G G G G
RED KINESCOPE SIGNAL
(D)
R R R R R R R R R R
SECOND-SCAN BLUE KINESCOPE SIGNAL
(E)
B B B B B B B B B B B B B B B B B B B B
FIRST SCAN BLUE KINESCOPE SIGNAL

FIG. 3—Color sampling sequence in the presence of varying color. Part E shows bandwidth-conserving interlaced dot action

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to sample for the lower half of the video band (up to 2 mc) and to use the mixed-highs principle for the upper half of the video band because this has technical advantages.

Color Television Receiver

Figure 4 is a block diagram of one type of color television receiver. The r-f, picture i-f, second detector, sound i-f, discriminator and audio circuits are identical with those of a conventional black-and-white receiver. The composite video and synchronizing signals from the second detector enter a sync separator

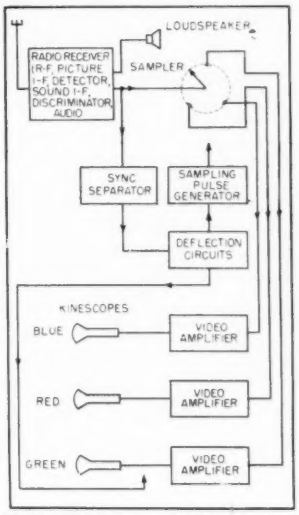

FIG. 4—Block diagram of RCA color television receiver

which removes the video and sends the synchronizing pulses to the deflection circuits and to the sampling pulse generator. The sampling pulse generator utilizes the trailing edge of the horizontal synchronizing pulse to actuate the receiver sampler in synchronism with the transmitter sampler.

The composite signal from the second detector also enters the sampler. The electronic commutator samples the composite signal every 0.0877 microsecond, producing the short pulses shown in Fig. 5A. The amplitude of each of these pulses is determined by the amplitude of the composite wave at that particular instant.

The commutator feeds these

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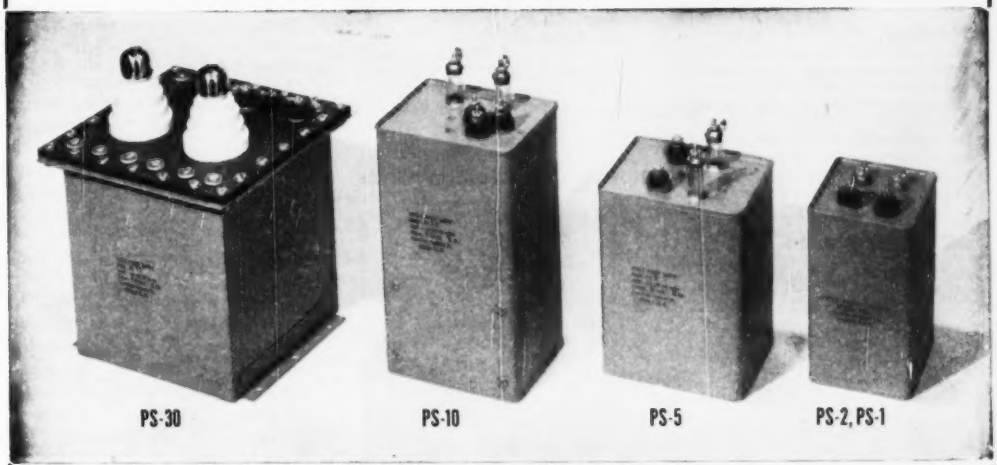

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PS-2-2400 VDC; 5 Ma.; dimen. $3\frac{3}{4}$" x 3 3/16" x $5\frac{1}{2}$"

PS-1-2400 VDC — Capacitor load; dimen. $3\frac{3}{4}$" x 3 3/16" x $5\frac{1}{2}$"

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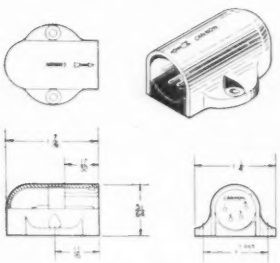
CANNON NEWS

Miss Bettie Anderson, Cannon employee, holding the first issue of the technical house organ published by the Cannon Electric Development Company, "The Cannonade", which appears bi-monthly. It is full of interesting material about Cannon products, their uses, and personalities in the business. We will be glad to put your name on the mailing list.

JOBBER ITEMS IN THE "XL" SERIES



XL-4-42 Receptacle

Shown above are the dimensional views of the XL-42, together with a production illustration. This fitting is adaptable to mounting under tables, and in areas where mounting problems are present. The four 10-amp. contacts are rated at 250 volts. The shell is zinc, nickel-plated, and may also be had with three 15-amp. contact inserts. XL-4-42 lists at $1.00; the XL-3-42, at 90c.

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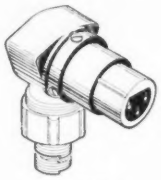

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In applications where an angle 90° plug is required in the Type "XL" Series, the XL-15 has been developed by borrowing an end bell from the Cannon Electric Type "K" Series. Other features of the XL-15 are identical to the standard XL plugs, such as latch-lock, gland nut and cable relief springs, together with the quality, full-floating socket contacts.

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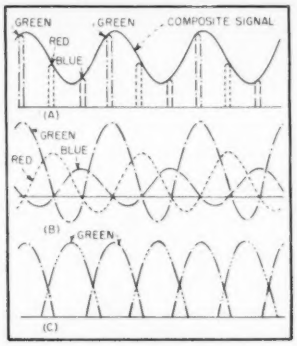

FIG. 5—Composite signal from second detector is sampled, as shown, giving sine wave (after filtering) proportional to color intensity

pulses into three separate video amplifiers which in turn control three cathode-ray tubes or kinescopes having appropriate color-producing phosphors. The video amplifiers have a flat response to 4 mc, gradually drop off in response from that frequency to 7 mc and have great attenuation above 7 mc.

The sampler sends the pulses to each of the video amplifiers and its attendant kinescope in succession. For instance, in Fig. 5A, the first green pulse goes to the green kinescope, the next pulse goes to the red kinescope, while the third pulse is sent to the blue kinescope. The green kinescope receives the fourth, seventh, tenth, and so on. Thus while the individual pulses coming out of the sampler are 0.0877 microsecond apart, the green pulses going to the video amplifier for the green kinescope repeat every 0.263 microsecond. The green channel pulses passing through the video amplifier lose all frequency components except the fundamental frequency of 3.8 mc and the d-c component. The resultant smoothed green signal is shown in Fig. 5B. The green, red, and blue signals are shown in superposition on this figure for illustration. It should be remembered that at this point the green signal shown is that fed to the green kinescope, while the red and blue signals are applied to their individual kinescopes.

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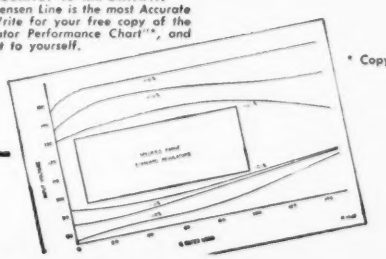

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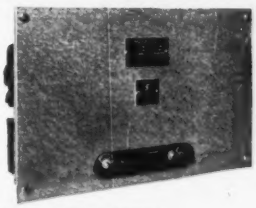
STANDARD AC SPECIFICATIONS

MODEL IN VA CAPACITY	150S 500S	250S 1000S	2,000S 3,000S	5,000S 10,000S 15,000S
Harmonic Distortion	3% max.	2% max.	3% max.	3% max.
Regulation Accuracy	±0.1% against line or load			
Input Voltage	95-130 VAC; also available for 190-260 VAC Single Phase 50-60 cycles			
Output Voltage	Adjustable between 110-120; 220-240 in 230 VAC models.			
Load Range	0 to full load			
P. F. Range	Down to 0.7 P. F. All models temperature compensated.			
NOTE: REGULATORS CAN BE HERMETICALLY SEALED				



STANDARD DC SPECIFICATIONS

*Output Voltage	6	12	28	48	125
**Load in Amperes	5-15-40-100	5-15-50	5-10-30	15	5-10
Input Voltage	95-130 VAC single phase 50-60 cycles; adapter available for 230 VAC operation.				
Regulation Accuracy	0.2% from 0.1 to full load.				
Ripple Voltage RMS Maximum	1%.				
Recovery Time	0.2 seconds-value includes charging time of filter circuit for the most severe change in load or input conditions.				

*Adjustable + 10% —25%.
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composite signal is sampled for green by a narrow pulse at the receiver at this exact instant, the receiver sampling pulse is a true measure of the green signal and includes no dilution from the red or blue signals. Likewise, the red and blue samples are each taken at points on the composite signal where no cross-talk is contributed from the other two color signals.

Assuming that the kinescope actually cuts off with negative applied signal, and neglecting the nonlinearity of the input control-voltage vs light-output characteristic of the kinescope, the solid lines of Fig. 5C may be regarded as the effective light intensity along one line scan on the screen of the green kinescope. A single line scan on the green channel lays down a series of green dots on the screen as shown by the solid lines. These dots occur at a 3.8-mc rate. If fine detail were involved to such an extent that two adjacent pulses in the green channel in a single line scan were of different amplitude, it is basic that the highest frequency component of use in establishing picture detail would be a sine wave which went from a crest to a trough in the time between the two adjacent green pulses. This sine wave would then have a frequency of 1.9 mc.

Interlacing of Dots

The fact that each pulse has a rise equivalent to twice this frequency allows the use of picture-dot interlacing to secure full detail up to 3.8 mc. This is accomplished by shifting the sampling pulses the next time that the same line is scanned so that the dots are then laid down between the dots that were laid down in the first scan. This second series of green dots is shown by the broken curves in Fig. 5C. In this figure, the dots shown by broken curves are the same amplitude as the dots shown by the solid curves. For resolution of very fine detail the dots laid down in the first scan would differ in amplitude from the dots laid down in the second scan of this same line. Figure 3E shows the signal at the blue kinescope for the first scanning of the line, with the dotted line showing the kinescope voltage for the

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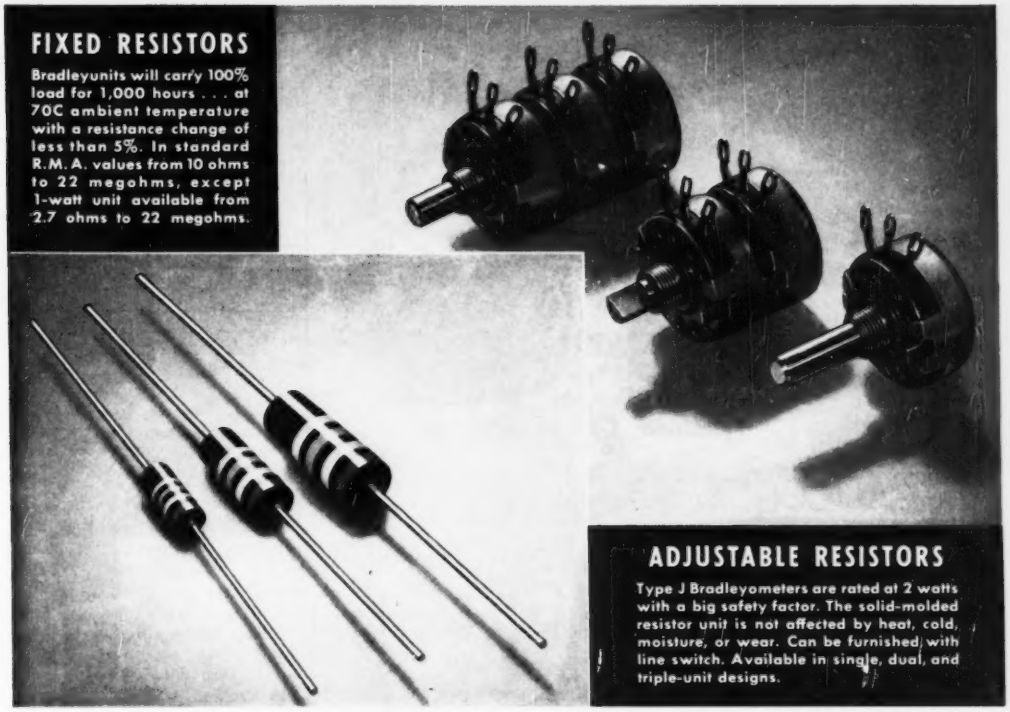

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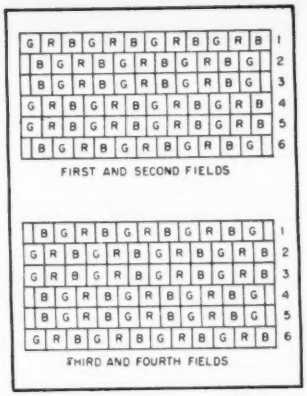

FIG. 6—Scanning sequence for RCA color television system. Each square represents a dot on the screen

second scanning of the same line.

While a single line scan lays down a series of green dots on the screen with space between dots, this space is completely filled at the same time by red and blue dots, with great overlapping of the dots.

Scanning Sequence

The scanning sequence used in the RCA color television system is illustrated in Fig. 6. Here each square represents a dot on the screen. Because of the overlapping of dots, each square should be approximately fifty percent longer than shown.

During the first scanning field, illustrated by the upper diagram in this figure, the odd numbered lines are scanned in order. That is, the three colored dots are laid down in order along line 1 as shown. Next, line 3 is scanned with a displacement of one and one-half squares for each color. The remaining odd lines are scanned in order with the color dot pattern shown. This scanning of the first field takes place in one-sixtieth of a second. During the second field, the even lines are scanned, first line 2 with the colors laid down in overlapping dots as shown, then line 4 and so on. The dot pattern laid down during the third field is shown by the lower diagram, where the odd lines are scanned in succession. During the fourth field, the even lines are again scanned in succession with the color dot pattern shown.

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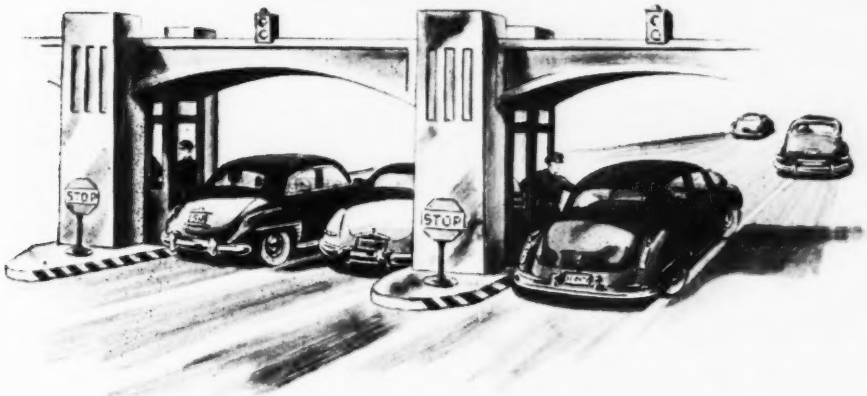

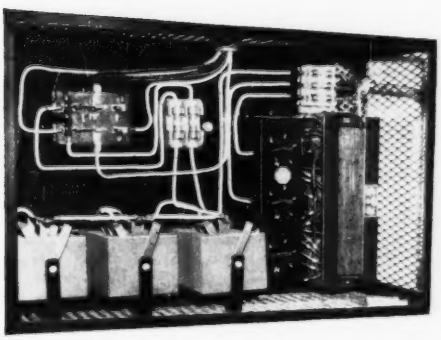

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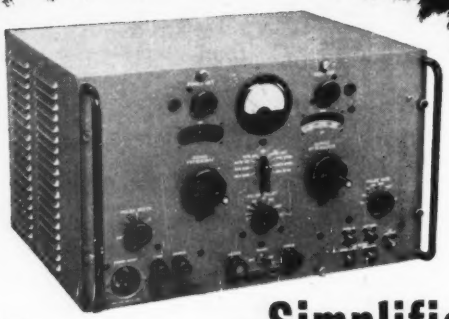

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during the first field, but dots of the same primary color are separated by spaces. The even lines are scanned during the second field, again with spaces between like color dots. During the third field, the odd lines are again scanned but with color dots displaced so that the spaces are filled. The even lines are scanned during the fourth field, with the color dots displaced to fill in the spaces left during the second field scanning. Four scanning fields are required to completely cover the picture area, with all spaces filled, with say, green dots. Simultaneously, the area is being covered with red dots and with blue dots. Since there are 60 fields per second, it may be said that there are 15 complete color pictures per second. It should be remembered that the effective field rate for large-area flicker is 60 per second, the same as for current black-and-white receivers. At viewing distances such that the picture line structure is not resolved, the effect of small-area flicker due to line interlace and picture-dot interlace is not visible.

Compatibility

When the radio signal from the RCA color television system is received, on a current black-and-white receiver, in good adjustment, the output of the second detector is represented by Fig. 2H, or, when the picture is of varying color, by the envelope of Fig. 3B. With mixed-highs also transmitted as shown in Fig. 1, the black-and-white receiver then develops on its kinescope a black-and-white picture with full resolution. The 3.8-mc sine wave superimposed on the picture signal produces a dot pattern on the kinescope, but due to interlace and line structure the dots are not visible at normal viewing distance.

In a laboratory setup, using the standard wedge pattern to test horizontal resolution, the same resolution figure was obtained when reproducing the color transmission on an unchanged current model black-and-white receiver as with the same receiver on a well-designed, well-adjusted, black-and-white system using present broadcast standards. The same resolution figure was also obtained when reproducing

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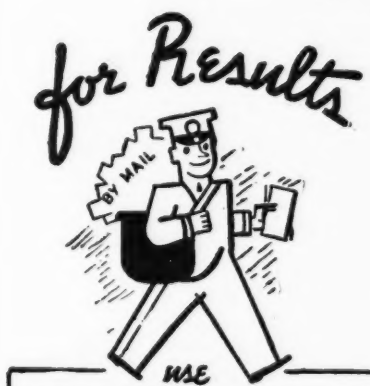

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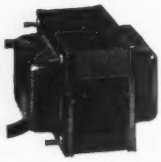
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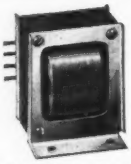
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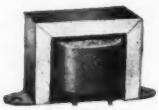
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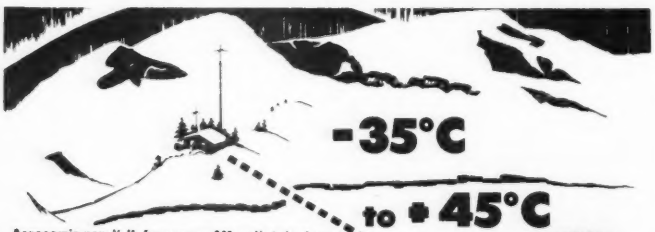

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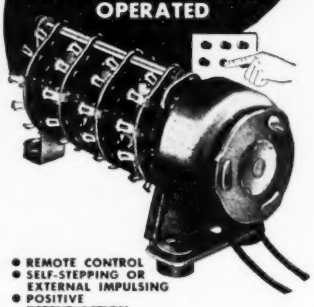

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the color transmission on a color receiver.

For color transmissions received on a color receiver, band saving is accomplished for the radio channel, by the sampling process wherein the color signals are transmitted in time-multiplex fashion. Further band saving is achieved through picture-dot interlacing. At the receiver the effect of the greater bandwidth is restored by the inverse sampling and by circuit arrangements to scan so as to picture-dot interlace.

For color transmissions received in monochrome on a current black-and-white receiver no band saving is involved, but because the transmitted signal contains all the resolution which a black-and-white signal of the same scene would have, the resulting monochrome picture will have the full resolution of the current standards.

To adapt a current black-and-white receiver to receive color transmissions in color will require the addition of circuits to accomplish the inverse sampling a picture-tube viewing arrangement or combination and associated power supplies.

Cathode-Ray Presentation for Infrared Spectrometer

By John H. Jupe
Middlesex, England

Visual presentation of infrared spectra on a long-persistence cathode-ray tube is now feasible for industrial and scientific research with a unit developed by Marconi Instruments Ltd., England. In its present form the instrument is capable of scanning a band about 3 microns in width anywhere in the range of 2 to 16 microns in a total time of some 15 seconds. Such rapid examination of the spectrum of a sample is particularly useful when the spectrum is changing rapidly, as in chemical reactions.

The spectrometer used with this cathode-ray apparatus may be any commercial type modified so that the prism moves synchronously with the time base.

The source of infrared radiation is from a Nernst filament or Glow-

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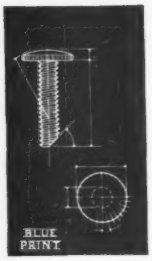

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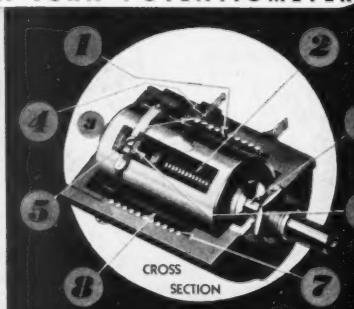

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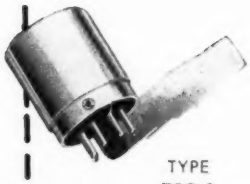

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bar element. After being mirror-focussed, the radiation is interrupted by a 20-cps chopper disc, so that the voltage pulses developed by the radiation detector, bolometer or thermopile may be amplified by an a-c amplifier.

A cam or gear assembly can be used to give the prism drive the required scanning range. A simple gear-changing mechanism is best, as the wavelength is not a linear function of the rotation of the prism. To cover a given range at any part of the spectrum a number of cams would be needed.

The voltage pulses from the radiation detector are fed into an a-c amplifier having a total gain of 100 db at 20 cps and a flat response between 1 and 40 cps. The rectified unsmoothed output may be coupled to the Y-plates of the c-r tube via a deflection amplifier, so that each radiation pulse will be represented by a proportional deflection on the screen. Alternatively, the rectified output of the amplifier may be smoothed by an R-C filter and used to control the amplitude of a 500-cps square-wave carrier, the circuit being adjusted so that zero energy falling on the detector will give a very small carrier amplitude. The modulated 500-cps signal is amplified by a single variable-gain stage and finally by a paraphrase amplifier in which the two anodes feed the Y-plates of the c-r tube. Between the variable-gain stage and the grid of the paraphase amplifier is a d-c restoring circuit (clipping circuit) with adjustable bias, which permits the modulation envelope to be displayed relative to

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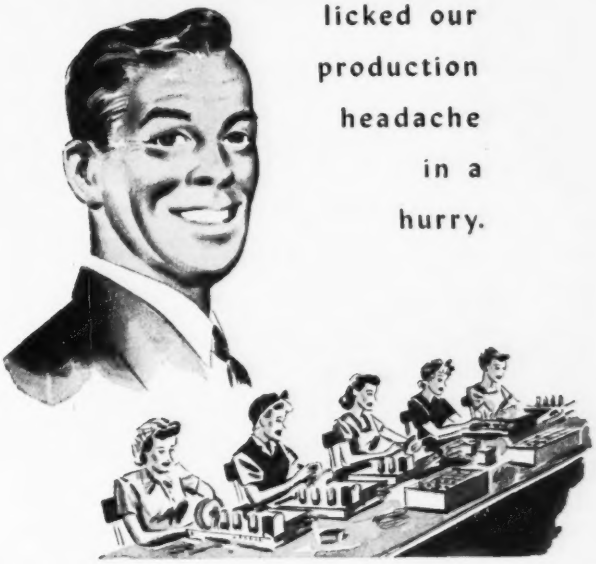

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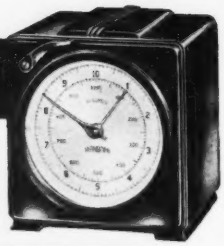

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SM-60	1/100 min.	60 min.	±.002 min.
S-10	1/10 sec.	1000 sec.	±.02 sec.
S-6	1/1000 min.	10 min.	±.0002 min.
S-1	1/100 sec.	60 sec.	±.01 sec.
MST	1/1000 sec.	.360 sec.	±.001 sec.
MST-500	1/1000 sec.	30 sec.	±.002 sec.

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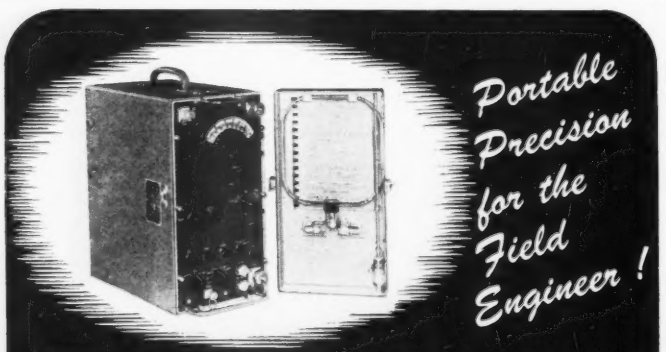

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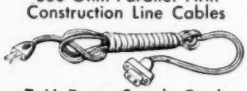

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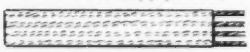

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The advantage of using a 500-cps square-wave carrier system is that the c-r tube spot remains stationary for a considerable fraction of each cycle, thus giving bright upper and lower limits to the trace.

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Square Wave Calibrator

By CHARLES MARKEY and HERBERT L. POLAK

Department of Neurology
College of Physicians and Surgeons
Columbia University and the
Neurological Institute of New York

ELECTRICAL ACTIVITY encountered in biological research may be recorded permanently for visual inspection by means of a cathode-ray tube and a camera with continuously moving film.

To obtain the most information from the recorded data, some equally permanent system of calibration must also be employed. The square wave generator shown in the accompanying circuit diagram may be used for calibrating the amplitude of the input signal down to a few microvolts and for indicating time on the record.

The basic circuit of the square wave calibrator consists of two

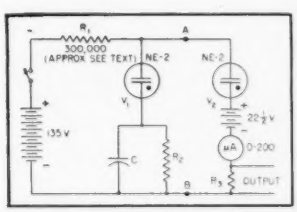

FIG. 1—Circuit diagram of square wave calibration signal generator for 0.1 to 1,000 cps

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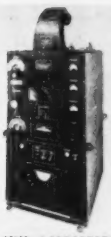
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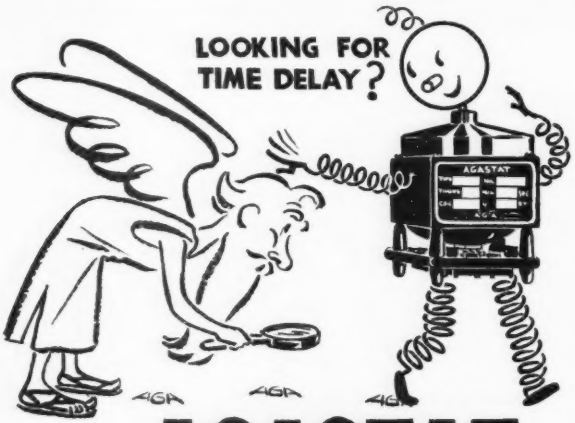

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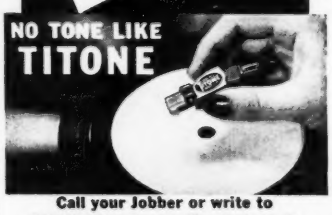

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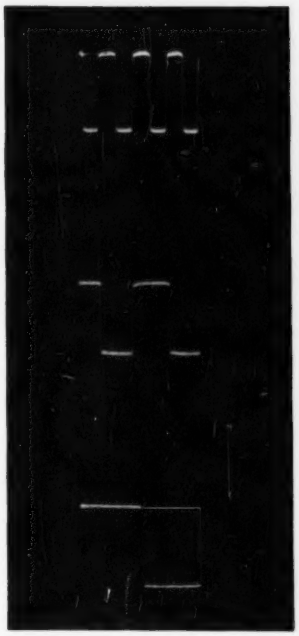

Fig. 2—Wave shapes obtained at 1,000 cps (top), 500 cps (center) and 250 cps

gaseous discharge tubes as shown in Fig. 1. GE type NE-2 neon lamps are used since they meet the requirements for wave shape, high-frequency limit and stability of operation, and have the additional advantage of requiring no heater power. The calibrator is entirely battery operated to eliminate a-c ripple from its output.

Square waves with frequencies as low as 0.1 cps and as high as 1,000 cps are easily obtained with this circuit, as shown in Fig. 2. This range is covered in steps by changing C and R_2 simultaneously. Upon closing the switch, V_1 will ignite first because V_2 has an opposing battery bias. As V_1 conducts it will charge C and build up a biasing voltage opposing the voltage across AB.

As the charging current decreases so will the voltage drop across R_1 and the potential across AB will rise and cause V_2 to ignite. The ignition of V_2 will draw a larger current through R_1. The voltage drop across this resistor will increase suddenly and the potential across AB will fall almost instan-

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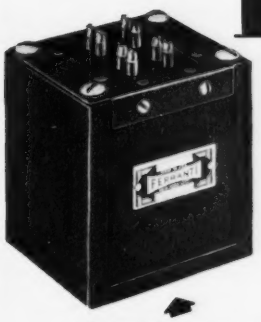

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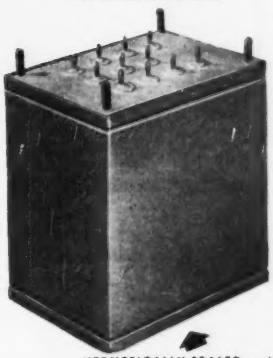

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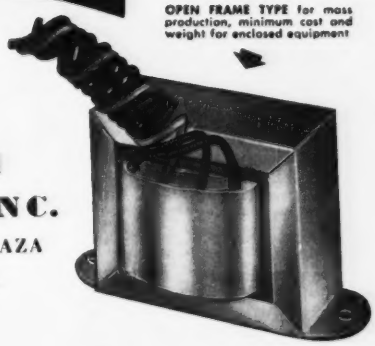

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DO YOU KNOW?

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. . . . add attraction — safety — service?

Ask **DIALCO**

— what lamp to use
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— what it will do
— what it will cost

THIS MAY BE THE ONE

Designed for low cost NE-51 Neon

- Built-in Resistor
- Patented
- U/L Listed
- Rugged

Catalogue Number 521308 — 997 for 110 or 220 volts.

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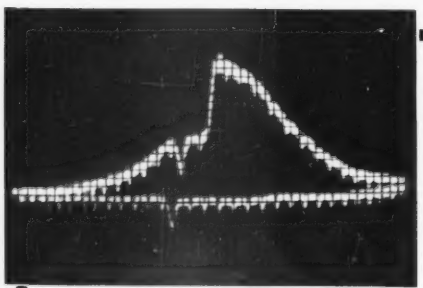

Illustration shows a Diesel engine performance curve. Ignition was about 8 degrees after top dead center. Peak pressure occurred 13 degrees after top dead center, thus angular position of crank is more favorable for efficiently converting pressure thrust into mechanical rotation. Small markers on curve are 5 degree indications, larger markers, top dead center.

PREVENT OFF-FIRING DAMAGE

maintain a perfect pressure-time curve with the

SYNCRO-MARKER PRESSUREGRAPH

Instantly Shows whether you're firing on top dead center. Off-firing may mean broken piston rings, crankshafts, other damage. The Pressuregraph gives you a full detailed picture of the firing, of pressure variations, both regular and instantaneous. It measures pressure rise with time, accurately and precisely, from vacuum to 14,000 PSI.

The Pressuregraph provides oscillograph pictures which show relation of pressures to engine shaft rotation (top dead center), relation of pressures to time (milliseconds) or indications in degrees of rotation. Also applicable to gas, steam or hydraulic line measurement of static, dynamic or instantaneous pressures. Installation requires only threaded hole in region where pressure is to be checked.

TODAY . . . *Write For Booklet, "Electronic Methods For Measurement Of Pressure And Displacements"* ▶

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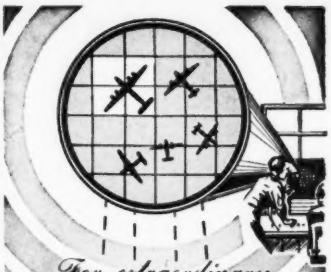

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taneously. This drop in voltage together with the acquired capacitor biasing voltage will extinguish V_1. While V_2 is conducting C will discharge through R_2; V_1 will thereby lose its biasing voltage and ignite.

Simultaneously with the ignition of V_1 the voltage across AB will drop suddenly and extinguish V_2, and the cycle will repeat. A steady d-c voltage appears across output resistance R_3 when V_2 conducts, and no voltage appears when V_1 conducts. The circuit parameters are adjusted properly when the conduction periods of V_1 and V_2 are equal, resulting in a square wave.

Initial Adjustments

The circuit is adjusted as follows: the branch through V_1 is opened, allowing V_2 to conduct. Resistor R_1 is varied until the meter registers the full-scale value of 200 microamperes. Having determined R_1 in this way, it is now fixed for all frequencies.

The output voltage will be $0.0002 \times R_3$ volts, peak-to-peak. A step potentiometer may be substituted for R_3 to obtain a range of known output voltages. The value of R_3 should be negligible in comparison to R_1. Reconnecting the branch through T_1 and selecting a value for C, R_2 is adjusted until the pulse width (T_2 conducting) is equal to the pulse spacing (T_1 conducting).

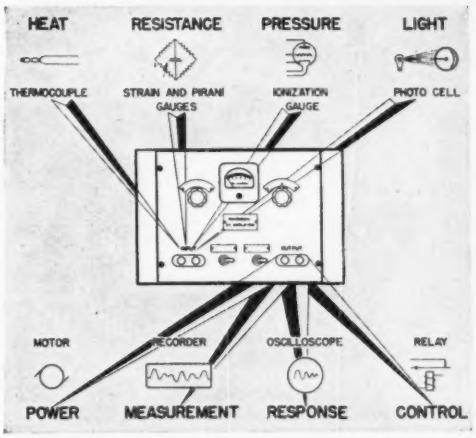
The lowest frequencies are correctly adjusted when the duration of meter deflection is equal to the duration of no deflection. At the higher frequencies, where the meter cannot follow the rapid changes, the correct adjustment of R_2 will show an average deflection of half scale or 100 microamperes. After adjustment the meter may be eliminated entirely.

Electronic Watch Timer

BY JOHN H. JUPE
Middlesex, England

A RECENTLY-DEVELOPED METHOD of testing watches is employed in an electronic watch timer now being produced by a British firm. It depends on the ticks of the watch being picked up by a microphone, amplified and compared with a

MICROSEN D. C. AMPLIFIER

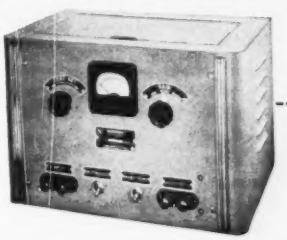


Performance plus Versatility

THE Microsen D. C. Amplifier provides stable and accurate amplification that is simple in operation, compact in design, moderate in cost. Particularly adaptable to laboratory and field work, the Microsen Balance principle assures the advantages of high gain with stability and fast response. The versatility and scope of this electronic instrument opens new fields in engineering research and process development work.

Line voltage variations of 15 per cent cause output changes of less than .5 per cent. There are no mechanical rectifiers or choppers. Tubes are standard. Time constant from .001 to .2 seconds. Drift less than 5 microvolts per day.

Models available include Voltage, Current and Potentiometer Type Amplifiers, Direct Current Converters, Direct Current Transformers and engineered designs to meet special requirements.



For complete data including operation, applications, advantages and specifications—write for the Microsen D.C. Amplifier Bulletin.

MAXWELL MANNING MM&M MOORE INC. TRADE MARK

MICROSEN
D. C. AMPLIFIER

A Product of
MANNING, MAXWELL & MOORE, INC.
STRATFORD, CONNECTICUT

Makers of 'Microsen' Electrical and 'American' Industrial Instruments, 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

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In Electronics, Stainless Meets Every Test Devised for Fastenings!

Non-magnetic, resistant to corrosion or vibration, impervious to heat or cold, permanent . . . whatever the quality you demand, count on stainless fastenings to provide the most efficient answer! Reduce maintenance and look for longer life with stainless!

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Anti-Corrosive, America's oldest and largest supplier dealing *exclusively* in stainless fastenings, carries this tremendous stock for your convenience . . . plus a special order service available for occasional odd sizes.

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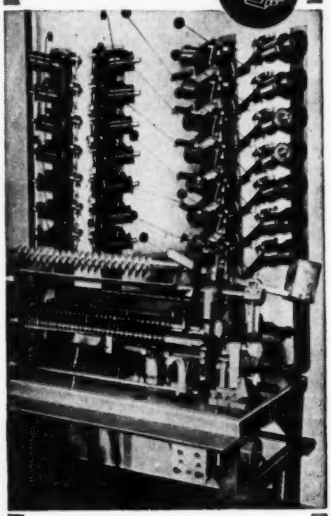
WIND more COILS faster

WITH YOUR PRESENT COIL-WINDING MACHINE!



— use PAMARCO

Wire DeReeling Tensions for PERFECT COILS

Installation of these inexpensive PAMARCO tensions lowers winding costs because each machine will accommodate *more* coils at *higher* winding speeds. In addition to increased production, PAMARCO tensions raise production quality. Free-running action practically eliminates wire breakage and shorted turns. Simple thumb screw setting quickly adjusts for any wire gauge. No tools or special skill are needed for operation. For complete data call or write.

PAPER MACHINERY & RESEARCH, INC.

1014 OAK STREET
ROSELLE, NEW JERSEY

standard frequency, and the difference being presented on a cathode-ray tube.

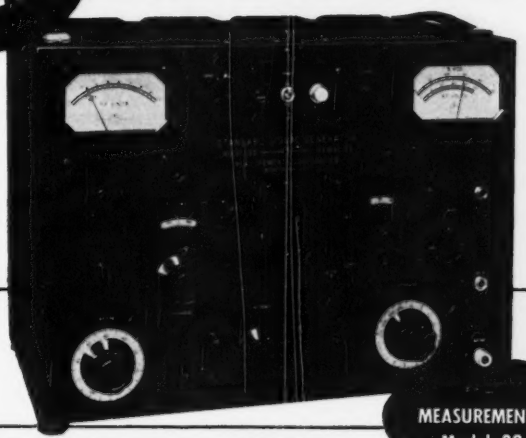
The alternating voltage from the standard has a frequency of 20 cps and is supplied by a crystal-controlled oscillator and a series of frequency dividers. This voltage causes a spot to rotate 20 times a second on the screen of the cathode-ray tube and gives the impression of a circle. The brightness of this circle is adjusted so that it is just invisible when a watch is not being tested. When a watch is placed on the test table the tick is picked up and amplified and the signals used to increase the brilliance of the spot so that it can be seen at one point in its path. The spot moves in a clockwise or counter-clockwise direction according to whether the watch is gaining or losing, and the distance through which it moves around the circumference of the circle in a given time shows the rate at which the watch is gaining or losing.

SURVEY OF NEW TECHNIQUES

A RECENT British instrument development makes continuous magnetic records of six separate current or voltage waves on the surface of a rotating steel cylinder. The recordings are played back by a special magnetic scanning system and displayed on a cathode-ray tube. The apparatus was developed to record random electrical disturbances which occur at rare intervals. It can also be used to obtain records of excess current or voltage conditions in a power supply system.

ABSORPTION OF SOUND in sea water is due to magnesium sulfate (0.22 percent of sea water) rather than sodium chloride (2.69 percent), according to results of ultrasonic experiments by R. W. Leonard of the University of California. Waves at 60,000 cps were reduced to half-intensity at 200 yards in sea water as compared to 2,000 yards in fresh water, chiefly because of the magnesium sulfate.

NEW! STANDARD SIGNAL GENERATOR



MEASUREMENTS Model 82

20 CYCLES TO 50 MC. IN ONE INSTRUMENT!

THIS new *Laboratory Standard* is designed for the extremely wide frequency coverage of 20 cycles to 50 megacycles, employing two specially designed oscillators.

A low frequency oscillator, in the range from 20 cycles to 200 kilocycles, provides continuously variable, metered output from 0 to 50 volts across 7500 ohms. This is sufficient for most measurements at audio and supersonic frequencies. It may also be used as the modulator for the radio frequency oscillator.

A radio frequency oscillator covers the range from 80 kilocycles to 50 megacycles. It provides metered output, continuously variable with an improved mutual inductance type attenuator, from 0.1 microvolt to 1 volt. This voltage range makes possible most receiver measurements including the determination of a.v.c. characteristics and interference susceptibility.

SPECIFICATIONS:

Frequency Range: 20 cycles to 50 megacycles. (20 cycles to 200 kilocycles in four ranges; 80 kilocycles to 50 megacycles in seven ranges; plus one blank range.)

Frequency Calibration: Direct reading dial, individually calibrated for each range.

Frequency Accuracy: 20 cycles to 200 kilocycles, accurate to ± 5%. 80 kilocycles to 50 megacycles, accurate to ± 1%.

Output Voltage and Impedance: 0 to 50 volts across 7500 ohms from 20 cycles to 200 kilocycles. 0.1 microvolt to 1 volt across 50 ohms over most of the range from 80 kilocycles to 50 megacycles. (Improved mutual inductance type attenuator.) The output voltage or impedance of either range can be changed by the use of external pads.

Modulation: (80 KC—50 MC range) Continuously variable from 0 to 50% from 20 cycles to 20 kilocycles by internal low frequency oscillator or external source.

Harmonic Output: Less than 1% from 20 cycles to 20 kilocycles; 3% or less from 20 kilocycles to 50 megacycles.

Leakage and Stray Field: Less than 1 microvolt from 80 kilocycles to 50 megacycles.

Power Supply: 117 volts, 50 to 60 cycles. 75 watts.

Dimensions: 15" high x 19" wide x 12" deep, overall.

Weight: 50 lbs.

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

THIS IS THE HORNET

A NEW MINIATURE POWER TRANSFORMER FOR USE IN AIRBORNE & PORTABLE EQUIPMENT

Illustration shows relative size of HORNET and conventional transformers of comparable capacity.

FEATURING

SMALLER SIZE

than any previous design, through the use of newly developed class H insulating materials, and design techniques. As shown above, HORNET transformers are only about one-fourth the size of similarly rated conventional transformers.

GREATER POWER OUTPUT

because of improved design and construction. HORNET transformers operate with unimpaired efficiency at high temperatures, and are suitable for operation at ambient temperatures as high as 150 deg. C. High output plus smaller size and lighter weight make these units ideal for use in airborne and portable equipment.

MEETS JAN SPECIFICATIONS

HORNET transformers are designed and built to meet requirements of current JAN T-27, and equivalent specifications.

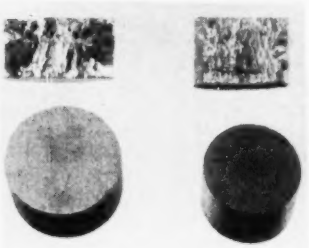
Write for descriptive bulletin of sizes and specifications

NEW YORK TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

nary or decade scaler, choice of scaling values; self-contained high-voltage supply from 500 to 1,600 volts; and a count rate meter with ranges of 500, 5000, and 50,000 counts per minute.

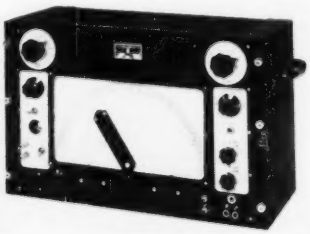
Permanent Magnet

GENERAL ELECTRIC Co., Pittsfield, Mass. Alnico 5 DG (directional gain) is a new permanent magnet material in which the crystal structure of the magnet is aligned in the direction of magnetization. As a result manufacturers who use permanent magnets may now use smaller magnets (comparison is illustrated) to do the same jobs formerly done by larger magnets. A reduction in the size of the loudspeaker magnetic frame and corresponding cost reduction is now possible.



Audio Sweep Generator

CLOUGH BRENGLE Co., 6014 Broadway, Chicago 40, Ill., announces an automatic audio sweep generator with a frequency of from 25 to 32,000 cycles in one continuous range. The automatic sweep may be adjusted in that range to any spread from 500 to 10,000 cycles, or the instrument may be operated manually. Waveform distortion is



Titeflex

FLEXIBLE WAVEGUIDES

Save Money

IN VIDEO TRANSMISSION

Titeflex Waveflex Waveguides used in television transmission. Assembled lengths of Waveflex over 30 feet long connect movable antenna with transmitter inside building. Antenna is directed at Empire State Bldg. faintly visible in background.

Titeflex Waveflex Waveguides give you all the advantages of rigid waveguides *plus* the additional feature of flexibility. Complicated bends and twists can be made with virtually no change in electrical properties . . . installation costs are lowered . . . design problems are simplified. Waveflex Waveguides are made in many standard types to Army-Navy specifications—or our engineers will develop special styles for you.

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COMPLETE WAVEFLEX CATALOG

TITEFLEX, INC.
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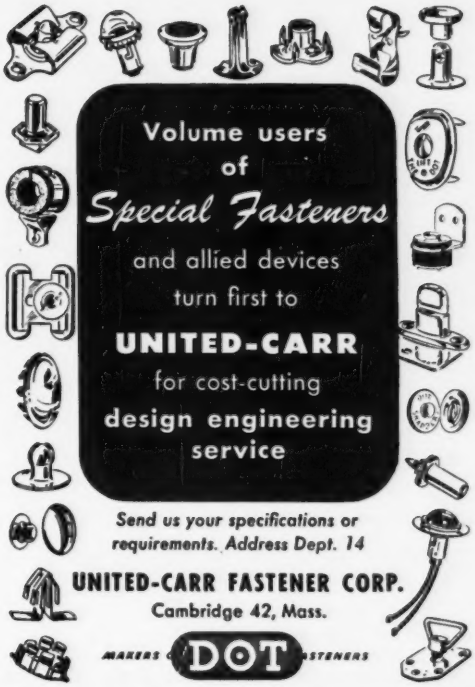

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Lewis can give you the answer

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD *consult*

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Wire Division
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S.S.WHITE flexible shafts and S.S.WHITE *brains*, too!

For over 70 years these brains have been thinking about flexible shafts. They have been studying and planning how to make them better, smoother running, longer lasting. They have worked out a wide range of successful applications. They have, in fact, accumulated a vast knowledge of flexible shafts and experience as to what they can do and can't do.

The point is—these brains are ready to work for you on any problem dealing with the application of flexible shafts for power drives or remote control. They can save you time and trouble because, in all possibility, they already have the answer to your problem. They may help you reach a more satisfactory answer, because the application of flexible shafts to all kinds of requirements and conditions is their special business.

S.S.White MAKES IT RIGHT

WRITE FOR THIS FLEXIBLE SHAFT HANDBOOK

It contains 260 pages of facts and engineering data about how to select and apply flexible shafts. A copy sent free if you ask for it on your business letterhead and mention your position.

S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. DEPT. E 10 EAST 40th ST., NEW YORK 16, N. Y.

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MOLDED PLASTICS PRODUCTS—MOLDED RESISTORS

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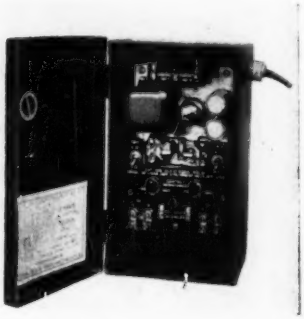
less than 0.5 percent and sweep calibration is linear, sweep frequency being adjustable from 2 to 10 sweeps per second. Complete construction and operational data are given in bulletin 22A.

Electronic Relay Switches

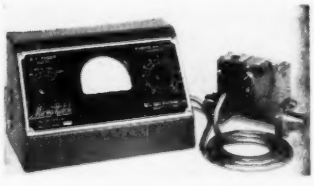
CORAL DESIGNS, P. O. Box 248, Forest Hills, N. Y., has available three types of relay switches for automatic controls and gaging devices: the Cat. 107 for two-position



control having two input terminals, the Cat. 108 (illustrated) for floating type control having three input terminals, and the Cat. 109 for gaging having three input terminals plus pilot lights to indicate measurements of out-of-tolerance. Contact ratings may be obtained for controlling 5, 10 or 35 amperes at 115 volts a-c.

R-F Power and SWR Measuring Unit

M. C. JONES ELECTRONICS CO., 96 North Main St., Bristol, Conn. The Model MM 560 series Micro Match is designed to provide direct readings of r-f power and vswr in the frequency range of 50 to over 500 mc. Power ranges of 0 to 12, 40, 120, 400 and 1,200 watts full scale are provided. The unit is useful in



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The Green Engraver offers great speed and convenience. Quickly cuts up to four lines of letters from 3/64" to 1" on curved or flat surfaces whether made of metal, plastics or wood . . . operates by merely tracing master copy — *anyone* can do an expert job. Special attachments and engineering service available for production work. Just the thing for radio, electronic apparatus and instrument manufacturers. Write today for Bulletin E8!

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INSULATION STRIPPED CLEAN IN SECONDS!
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1. Dip wire in X-VAR for 3 seconds, then withdraw.
2. Expose to air and watch coating disintegrate.
3. Wipe wire clean. Whole operation takes a matter of seconds.

X-VAR is non-corrosive and does not creep. Now in use by leading manufacturers of electrical products. *Write for FREE SAMPLE for testing.*

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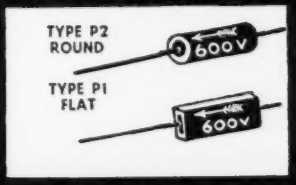

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FROM 100 VOLTS TO 600 VOLTS

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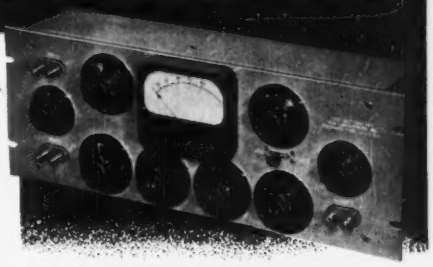
ELECTRIC CORP.
MFR'S OF CAPACITORS FOR EVERY REQUIREMENT
308 DYCKMAN ST., NEW YORK, N. Y.

NEW... Improved Wiring Eliminates Leakage

TYPE 12AT & TYPE 12ATK (KIT)
TRANSMISSION MEASURING SET

Range: 111 db. in 0.2 steps.
Frequency resp.: 0.1db. from 0 to 20 kc.
Accuracy: 0.1 db.
Impedance, load section: 4, 8, 16, 50, 150, 200, 500, & 600 ohms.
Impedance, transm. set.: 50, 150, 200, 500 & 600 ohms.
Reference level: 1mw. into 600 ohms.
Circuit: "T", unbalanced.
Attenuators: 10x10, 10x1 & 5x0.2 db.
Lead carr. cap.: Transm. sect. 1 w. Load section 10 w.



A precision Gain Set with specially developed wiring that permits no troublesome leakage and provides improved frequency characteristics. Available completely assembled, or in kit form—which permits the sale of a high accuracy instrument at a low price.

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TECH LABORATORIES, INC.
Manufacturers of Precision Electrical Resistance Instruments
PALISADES PARK, NEW JERSEY

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"AN" CONNECTORS

On sizes 20 and up, Amphenol provides 70% thicker inserts . . . stronger to withstand roughest handling.

Contacts are selected high conductivity bronze alloys, silver plated and with pockets pretinned for soldering.

Both coupling rings and assembly screws are cross-drilled for safety wiring in accordance with Army-Navy specifications.

AMPHENOL — the assurance of absolutely dependable, weatherproof, vibration-proof service.

Non-rotating contacts with solder cups are uniformly aligned . . . saves 40% in assembling time, lowers cost.

Coupling rings are a screw machine part made from solid aluminum bar stock providing 80% greater tensile strength.

FOR POWER, SIGNAL and CONTROL CIRCUITS in AIRCRAFT and ELECTRONIC EQUIPMENT

Amphenol engineers and technicians are available without obligation to assist in specifying the right type of "AN" connector for application in instrument, power and control problems. Amphenol "AN" Connectors are available in five major shell designs, each accommodating over 200 styles of contact inserts.

COMPLETE LISTINGS OF "AN" CONNECTORS

Write for your copy of Amphenol's comprehensive and illustrated catalog on "AN" and "97" Connectors. Please send request on company letterhead.

AMERICAN PHENOLIC CORPORATION

1830 SO. 54TH AVENUE • CHICAGO 50, ILLINOIS

the installation and operation of transmitting stations and also as a laboratory instrument. Accuracy is ± 5 percent of full scale for r-f power; ± 10 percent for swr.

Dual-Cone Speaker

RADIO CORP. OF AMERICA, Harrison, N. J. Model 515S1 Duo-Cone 15-inch speaker of the permanent-magnet type provides high sensitivity between 40 cps and 10,000 cps, and is capable of handling 25 watts input. A ¾-inch voice coil

drives the small cone section to produce the high frequencies; and a 2-inch voice coil drives the large cone section to produce the lower frequencies. The unit employs a 2-pound Alnico V magnet.

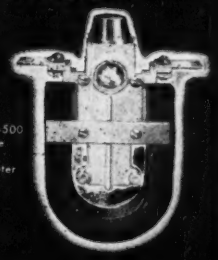
H-F Noise-Generating Diode

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. Type 5722 miniature noise-generating diode is suitable for noise measurements at frequencies up to 500 mc. It is operated with 150 volts on plate and at filament volt-

Specify... GM

D'ARSONVAL PORTABLE

GALVANOMETERS AND MOVEMENTS...



Series 570-500 Mirror-Type D-C Galvanometer

Ideal as a built-in component of other instruments—with the sensitivity and ruggedness that is especially desirable for Colorimetry, Densitometry, and various other measurements. Unit includes mirror movement, magnet and zero correction knob. Choice of 4 standard models.

Write us about your application and requirements

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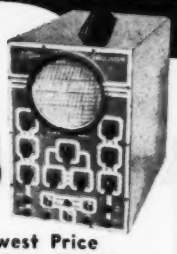
...has BOTH big features*



$39.95

*Lowest Price
*Laboratory Precision

When COST is a factor, and QUALITY is essential—specify EICO Model 400-K. Build the kit in just one evening—but enjoy a lifetime of dependable, accurate performance.

SPECIFICATIONS:

Deflection sensitivity: .65 volts per inch full gain. Horizontal sweep circuit: 15 to 30,000 cycles. Frequency response of vertical and horizontal amps is from 50 to 50,000 cycles. Complete with 5 tubes, PLUS 5BP1 CR tube. Handsome, 3-color, etched panel. Size: 8½" x 12" x 13" high. All components, punched chassis and simplified pictorial and schematic diagrams included. EICO Model 400-K is widely used in production, research, education, and AM-FM-TV servicing.

See your local jobber. Also available fully wired and tested.... $69.95

Write for Descriptive Catalog E

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Short cut to success with Molded Plastics

If you have a part or product to be molded of plastic, your nearest Watertown man will place our 34 years experience as custom molders of every type of plastic for thousands of different applications at your service.

If the job calls for development of a special molding compound, or close control of production, you profit from our laboratory . . . second to none in the industry. There we X-ray, push, pull, twist, pound and bake experimental and production samples . . . analyze their electrical, physical, chemical and mechanical properties . . . until you, and we, know the job is right.

Here are the Watertown men . . .

New York—H. A. Rankow, 175 Fifth Ave.
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Detroit—J. P. Groenor from Chicago
Cleveland—Carl F. Linn, 866 Hanna Bldg.
Milwaukee—Roger L. Miller, 729 N. Broadway
Seattle—John W. Witherow, National Vulcanized Fibre Co., 1927 First Ave., South
San Francisco—G. W. Harmsson, National Vulcanized Fibre Co., 273 Seventh Ave.
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THE WATERTOWN MANUFACTURING CO.
777 ECHO LAKE RD., WATERTOWN, CONN.

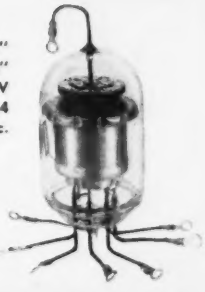
2 NEW CETRON THYRATRONS

CE329 CE330

CE-329—CE-330

Max. Hght. (ex. leads)	6"
Max. Diameter	2-1/16"
Filament Voltage	14V
Filament Current	2.4±.4
Heating Time	180 Sec.
*Anode Current	3 Amps.
Peak Inv. & Forw.	500 V
Grid Con. with 25V D.C. Anode	+1±1V
Deionization Time	200 Sec.
Amb. Temp. Min.	−54°C
Max.	+100°C

*CE-330—5 Amps.



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America's Leader in Quality Electronic Tube Manufacture
GENEVA, ILLINOIS

If you use choke coils, band-tuning coils, channel coils, contact coils and others for television assembly, and if you want them coated with plastic, cotton, nylon, enamel, lenzak, formvar, etc., you can depend on Lewis for your needs. *Coils are stripped and tinned, ready for assembly!*

Lewis has the facilities and experience for mass production of all types of television coils—and our efficient methods permit economical prices.

Whatever your requirements, have a Lewis Engineer call and check them, quote delivery and prices. No obligation.

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THE FINEST LIGHT SPRINGS AND WIREFORMS OF EVERY TYPE AND MATERIAL

ages ranging between 2 and 5.5 volts depending on desired plate current or noise output. In intermittent service maximum plate dissipation is 5 watts.

Radiation Detector

THE NUCLEONIC CORP. OF AMERICA, 499 Union St., Brooklyn 31, N. Y. Model RD-1 radiation detector was designed to supply the need of a low-cost battery-operated, Geiger

counter for prospectors. Two pounds in weight, the instrument may be clipped to the belt, allowing freedom of both hands. Clicks in an earphone and a flashing light indicate the presence of radioactive ore.

Plug-In Links

BARKER & WILLIAMSON, INC., 237 Fairfield Ave., Upper Darby, Pa. Matching of standard tank coils to a wide variety of impedances is possible with swinging link assemblies employing plug-in coils. New plug-in link coils are now available in 1, 3 6, and 10 turns. Plug-in arm type 3750 fits the HDV tank coil. Type 3550 is made to fit TVH, TVL, and BVL types. Bulletins are available.

Secondary Frequency Standards

HEWLETT-PACKARD CO., 395 Page Mill Road, Palo Alto, Calif., has developed two new secondary fre-

4 new members of the

TOP HAT RETAINER

family . . .

No. 1113
$1\frac{17}{32}$" I.D. For units similar to Clare type SK relay.

No. 1114
$1\frac{21}{32}$" I.D. For units similar to Advance relay.

No. 1115
$2\frac{1}{16}$" I.D. double post for type 4-65A tube, T-16 envelope.

No. 1116
For ST-19 envelope.

Stainless steel. Recommended for use in military electronic equipment.

Send for literature covering complete line of Top Hat Retainers.

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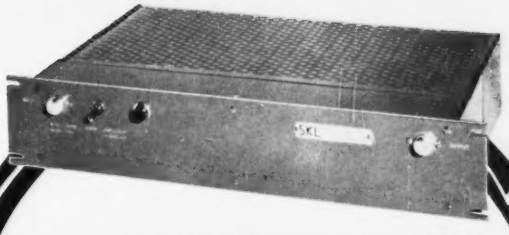

200 MC BAND WIDTH AMPLIFIERS

Model 202P Wide-Band Chain Amplifier with Regulated Power Supply.

Band Width: 100 KC to 200 MC. Gain: 20 db.
Impedance: 200 ohms. Rise Time: Less than .003 usec.
With the Model 202P: very fast pulses, transients and other high frequency voltages can now be amplified.
With the Model 202P: vacuum tube voltmeters and oscilloscopes are ten times more sensitive.
With the Model 202P: the output voltage of signal, sweep and pulse generators is ten times greater.

Other Wide-Band Chain Amplifiers available:
Model 200A — 10 db Gain. Model 204 — 40 db Gain.

Makers of chain amplifiers, temperature controls, variable electronic filters and power supplies.
Write for Bulletin 202P-1-E

SKL SPENCER-KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

THE NEW
BERKELEY
MODEL 700
DECIMAL COUNTING UNIT

This unique packaged component is *easily built into* your apparatus. It has *true decimal reading*, and simple binary circuit with reliable *automatic interpolation*. Miniature size. Moderate price. Immediate shipment.

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Berkeley Scientific Company
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IT WILL PAY YOU TO CONSULT THE NEW

IN·RES·CO CATALOG

Included are complete descriptions and specifications on wire wound resistors of all types and sizes. Each is precision wound to close tolerance, and many feature special moisture-proofing to assure proper functioning under severest climatic conditions. INRESCO Resistors —available for IMMEDIATE DELIVERY—are supplied in standard or custom types to meet the most unusual design or operational requirements, and are offered at prices that benefit from mass production facilities. A copy of the new INRESCO catalog will be helpful; write for it today. Prices, samples and estimates promptly on other than standard resistors.

INSTRUMENT RESISTORS COMPANY
1036 COMMERCE AVE., UNION, N. J.

Wire Wound Resistors for Every Use in Electronics and Instrumentation

THESE THREE
NEW DEVELOPMENTS
ARE
Keeping
ASTATIC
Out in Front
IN THE
MANUFACTURE OF
PICKUP
CARTRIDGES

1 GC CERAMIC CARTRIDGE

First major engineering stride in phonograph pickup cartridges employing ceramic elements since Astatic pioneered in this type unit last year. The GC is the first cartridge of its kind with replaceable needle. Takes the special new Astatic "Type G" needle—with either one or three-mil tip radius, precious metal or sapphire—which slips from its rubber chuck with a quarter turn sideways. Resistance of the ceramic element to high temperatures and humidity is not the only additional advantage of this new development. Output has been increased over that of any ceramic cartridge available. Its light weight and low minimum needle pressure make it ideal for a great variety of modern applications.

2 CQ CRYSTAL CARTRIDGE

An entirely new Astatic design, featuring miniature size and five-gram weight. Model CQ-J fits standard 1.2" mounting and RCA 45 RPM record changers. Model CQ-1J fits RMA No. 2 Specifications for top mounting .453" mounting centers. Needle pressure five grams. Output 0.7 volts at 1,000 c.p.s. Employs one-mil tip radius, Q-33 needle. Cast aluminum housing.

3 LQD Double-Needle Crystal Cartridge

The LQD Cartridge—for 45, 33-1/3 and 78 RPM Records—quickly became the first choice of many of the nation's largest users, on the basis of comparative listening tests, and is, today, the PROVED TOP PERFORMER for turnover type pickups. Outstanding for excellence of frequency response, particularly at low frequencies. A gentle pry with penknife removes ONE needle for replacement . . . without disturbing the other needle, without removing cartridge from tone arm. Gentle pressure snaps new needle into place. Available with or without needle guards. Stamped aluminum housing.

THE Astatic CORPORATION
ASTATIC
CONNEAUT, OHIO
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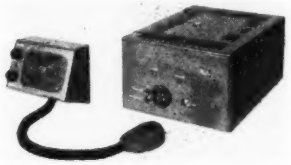
Astatic Crystal Devices manufactured under Brush Development Co. patents

quency standards, models 100C and 100D. The Model 100D provides rectangular timing pips at intervals of 100, 1,000 and 10,000 microseconds and an internal oscilloscope for convenient frequency comparison. It also produces sine waves at 5 frequencies and rectangular waves at 4 frequencies. Accuracy is in the order of 2 parts in 1 million. The 100C gives sine waves only, at 4 crystal-controlled frequencies with a 0.001-percent accuracy. Both models provide 5 volts output and operate from 115-volt regulated a-c power supply.

Mobile Radio Equipment

RADIO CORP. OF AMERICA, Camden, N. J., has developed the Fleetfone, a highly-selective two-way mobile communication system for operation in the 30 to 50-mc band. It contains a newly developed circuit for automatic modulation control which locks the voice input level at a constant amplitude. For operation from a 6-volt battery, it is available with either 30 or 60-watts output. There is also a 30-watt



model which operates from a 12-volt battery. The equipment has provision for either single-frequency or two-frequency operation. Cable from transmitter-receiver to control unit and battery measures 16 feet 8 inches.

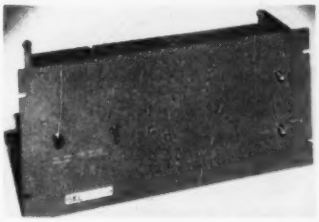
D-C Motor

BENDIX AVIATION CORP., Red Bank, N. J., has announced a new d-c motor designed to meet all the requirements of the new Army-Navy specification ANM-40. It is guaranteed

to be noise free within specification limits from 0.15 to 156 mc. These limits are maintained through the required ambient temperature range of -55 C to + 71 C. The motor can be supplied for voltages from 12 to 64 volts d-c

Wide-Band Chain Amplifier

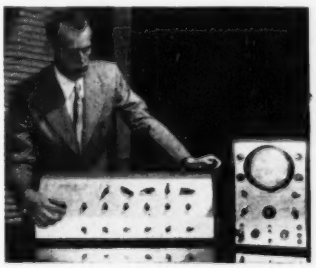
SPENCER-KENNEDY LABORATORIES, INC., 186 Massachusetts Ave., Cambridge 39, Mass. Using a traveling-wave circuit, the Model 204 wide-band chain amplifier has a bandwidth of 200 mc and a gain of 40 db.



With an impedance of 200 ohms and a nominal transmission characteristic of ± 1.5 db from 100 kc to 200 mc, the amplifier has a substantially linear phase shift. The unit is suitable for use with pulse and signal generators, vacuum-tube voltmeters and television testing equipment.

Harmonic Generator

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has developed a portable harmonic generator for the demonstration of wave shapes and properties of electrical circuits. It consists of six voltage-generating units mounted on a single shaft and driven by a synchronous motor. Outputs obtained are a fundamental voltage and five harmonic voltages having frequencies two, three, four,



SHOCK AND VIBRATION NEWS

There's a BARRYMOUNT for each of your needs!

AIRCRAFT MOUNTING BASES

Standard bases with dimensions to government specifications. Special bases to customers' exact requirements.

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Unit isolators designed to meet Army, Navy, and CAA requirements. Stock mountings — 1/4 pound to 45 pound load range. Others on order.

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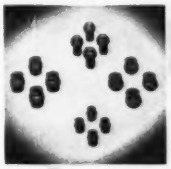
For mobile, railroad, and shipboard electronic and electrical equipment. Also for isolation above 2000 c.p.m., and for general sound isolation.



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For electronic components, tiny fractional H.P. motors, record changers, dictating machines, and other lightweight apparatus.

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For fans, motor generator sets, transformers, presses, and other heavy industrial equipment.

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THE KNURLED HEAD...

...performs Triple Duty!

UNBRAKO *KNURLED* SOCKET HEAD CAP SCREW

There is a definite saving of assembly time when you use "UNBRAKO" Socket Head Cap Screws with *Knurled* Heads. The exclusive knurled heads perform triple duty: (1) the *knurling* provides a sure, slipproof grip; (2) the *knurling* permits positive locking—a feature so often essential where there is excessive impact or vibration; (3) the *knurling* speeds assembly, because it enables the "UNBRAKO" to be screwed in faster and further with the fingers—handiest of all wrenches—before a "key" becomes necessary.

As always, the brand name "UNBRAKO" signifies *extra strength* and *precision manufacture to close tolerances.*

Knurling of Socket Screws originated with "Unbrako" in 1934.

"UNBRAKO" *Knurled* Socket Head Cap Screws are available in both National Coarse and National Fine Thread Series, in a full range of standard sizes. Other sizes to special order. Write us for your free copy of the "UNBRAKO" Catalog and the name of your nearest "UNBRAKO" Distrbiutor.

Other "UNBRAKO" Products include:

Socket Set Screws with *Knurled* Cup Points, Socket Set Screws with *Knurled* Threads, Square Head Set Screws with *Knurled* Cup Points—all patented, Self-Locking screws that won't shake loose! *Knurled* Socket Head Stripper Bolts. *Precision-Ground* Dowel Pins. *Fully-Formed* Pressure Plugs.

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TUBE CLAMPS

Stainless Steel — Corrosion Proof

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Where vibration is a problem, Birtcher Locking TUBE CLAMPS offer a foolproof, practical solution. Recommended for all types of tubes and similar plug-in components.

More than three million of these clamps in use.

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Send for samples of Birtcher stainless steel tube clamps and our standard catalog listing tube base types, recommended clamp designs, and price list.

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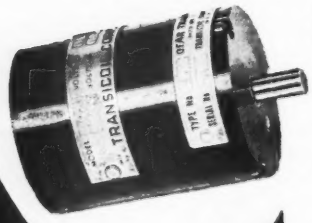
Save Space and Weight With New, Plate-to-Plate TRANSICOIL Control Motors



Low Inertia Motors, Precision Gear Trains And Combinations for 400 cycle or 60 cycle operation.

Direct plate-to-plate winding eliminates the output transformer in the servo amplifier. Wherever weight and compactness are important in a military or industrial control system, this new Transicoil design development is your logical solution.

- Varied housing designs suitable for all standard mountings.
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Linde HELIUM · NEON ARGON · KRYPTON · XENON

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five and seven times that of the fundamental. Waveshapes are made visible on an oscilloscope for demonstration purposes. Phase and voltage amplitude adjustments are provided by panel dials.

Aircraft Navigational Antenna

AIRCRAFT RADIO CORP., Boonton, N. J. Type A-13 vhf aircraft antenna is designed for reception of omnirange and runway localizer navigational signals. It covers the

band of 105 to 122 mc with a vswr of less than 2.5 into a 50-ohm coax line. Mounting is interchangeable with AS-27A/ARN-5.

Midget Resistors

PAINTON & CO. LTD., Kingsthorpe, Northampton, England. Type MV.1 midget wire-wound vitreous resistors are available in values between 1 and 4,700 ohms. Maximum working temperature is 300 C. Dissipation is 3 watts at 250 C rise. Dimensions are 13/64-in. in diameter, 15/32 in. long.

Tele and F-M Marker

RADIO CITY PRODUCTS CO. INC., 152 W. 25th St., New York 1, N. Y. Model TV50 is a marker designed

finer components provide the margin for finer instruments

5841

5841
REGULATOR

Regulated voltage	900 volts
Starting voltage	930 volts
Current	2 to 50 ua
Regulation	1.5%

1B87

1B87
THYRODE

Operating voltage	900 volts
Plateau length	100 volts
Max. slope	10%/100 V
Wall (glass)	200 mg/cm²

1B88

1B88
THYRODE

Operating voltage	300 volts
Plateau length	50 volts
Max. slope	30%/50 V
Wall (glass)	200 mg/cm²

5799

5799
RECTIFIER

Filament current	10 ma
Filament voltage	1.25 volts
Inverse peak	3000 volts
Insulation	10^{15} ohms

1B85

1B85
THYRODE

Operating voltage	900 volts
Plateau length	200 volts
Max. slope	3%/100 V
Wall (aluminum)	50 mg/cm²

5828

5828
AMPLIFIER

Filament current	10 ma
Filament voltage	1.25 volts
Amplification	18
Transconductance	450 umho

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SPECIFY AIR EXPRESS
AIR EXPRESS
GETS THERE FIRST

Rates include special pick-up and delivery door to door in principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE
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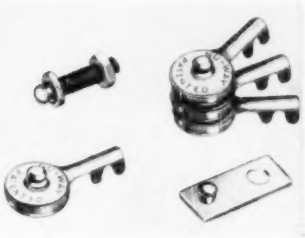
primarily for use with television sweep generators. Its dial is calibrated from 5 mc to 250 mc in 4 bands, with accuracy held to a tolerance within 1.0 percent. Tube complement consists of a 12AT7, 6C4, VR105 and 6X5GT/G. The unit operates on 105 to 130 volts, 60 cycles.

New Terminals

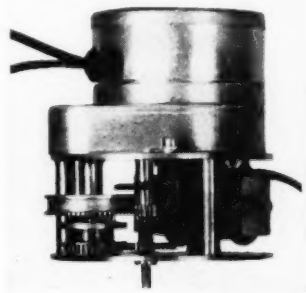
THE HATHEWAY MFG. CO., Bridgeport, Conn. The Nu-Way terminals eliminate all tape and soldering of wire connections. Any number may be pyramided on top of each other



for fast multiple connections. They are especially adaptable when wires must be switched or unfastened regularly. Units include terminals, lugs and studs which are made of brass, nickel plated for weather resistance and rigidity.

Synchronous Motor

THE R. W. CRAMER CO., INC., Centerbrook, Conn. Type SXC synchronous motor featuring a differential clutch mechanism is designed to meet the needs of many timing, recording, indicating and switching applications requiring an accurate reset operation. It produces 30 inch-ounces of torque at 1 rpm. The clutch unit consists of a differential,



internal tooth planetary gear system whereby the sun gear is directly coupled to the motor and the planet gears to the output. When locked by energizing an electromagnet, the internal gear causes the motor to drive the output shaft. De-energizing the electromagnet releases the internal gear and breaks the driving couple.

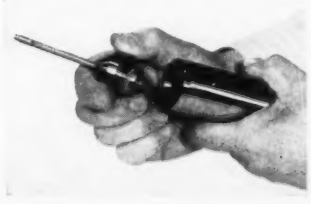
Beta-Ray Thickness Gage

GENERAL ELECTRIC CO., Schenectady 5, N. Y. The new beta-ray thickness gage continuously indicates deviations from a preset

thickness in moving sheets of rubber, plastics, metals, textiles, paper and other sheet materials. Accuracy of ± 2 percent is maintained with occasional calibration. It consists of three units, a gaging head, a control cabinet and an operator's control, all interconnected by heavy-duty multiconductor cable. Power required is 100 to 125 volts, 60 ± 0.3 cycles, single phase, 150 watts.

Sound Measuring Equipment

MASSA LABORATORIES, INC., 3868 Carnegie Ave., Cleveland, Ohio. Model GA-1007 sound pressure measurement equipment includes a tiny microphone attached to the tip of a flexible probe, which is, in turn, mounted to a plug that may be assembled to the preamplifier as illustrated. A built-in calibrating circuit permits checking absolute mag-



Courtesy United Electronics Company by permission of U. S. Navy

that's why graphite anodes meet Army-Navy specifications for "RUGGEDIZED" tubes

"Ruggedized" tubes are being developed for military use for maximum resistance to shock and impact. What's more, graphite anodes resist shock and distortion under impact and will not generate unusual microphonic or harmonic conditions. *The 838W Tube with the Speer Graphite Anode, shown above, has over 10 times the impact resistance of ordinary tubes.*

But high impact resistance is only *one* Speer Plus Factor. With Speer Graphite Anodes you're sure of:

200% to 300% higher power rating over metal anode tubes. That's due to the higher radiation emissivity and conductivity of graphite.

High frequency stability – because graphite won't warp, stays cool and maintains its characteristics. Result: warping of other tube elements is inhibited.

Longer life. Because graphite anodes operate at consistently lower temperatures, tubes last longer, even under constant severe usage; insure minimum heating of associated tube parts and reduce grid emission.

Laboratory tests and actual hard use have demonstrated the superiority of graphite anode tubes. For greater operating efficiency, economy and dependability, look for the tube with the graphite anode.

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With a wide range of stock arbors . . . plus the specialized ability to engineer special tubes . . . PARAMOUNT can produce the exact shape and size you need for coil forms or other uses. *Hi-Dielectric, Hi-Strength.* Kraft, Fish Paper, Red Rope, or any combination, wound on automatic machines. Tolerances plus or minus .002". Made to your specifications or engineered for YOU.

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Manufacturers of Paper Tubing for the Electrical Industry

COMPOUNDS

Scientifically compounded for specific applications from waxes, resins, asphalts, pitches, oils, and minerals. Available in wide range of melting points and hardnesses. Special potting compounds are heat conducting and crack resistant at extremely low temperatures. Recommendations, specific data, and samples will be furnished on request.

for

IMPREGNATING
radio coils
transformer coils
ignition coils
wire coverings
paper tubes and forms
porous ceramics

SEALING
condensers
batteries
switch base terminals
socket terminals
light fixtures

DIPPING
Coils
Transformers
Condensers

POTTING
Radio Transformers
Light Units
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Condensers

BIWAX CORPORATION
3445 HOWARD STREET
SKOKIE, ILLINOIS

FOR ORIGINALITY LOOK TO XCELITE

Built For RADIO Men — Not "HOBBY" Use!

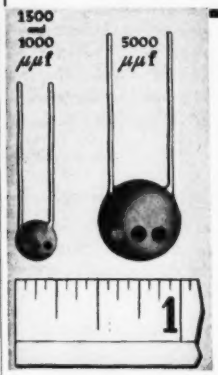
XCELITE PLIERS have features suggested by top radio and electrical engineers! Drop forged of special analysis tool steel! Carefully heat-treated! Keen, lasting hand-honed cutting edges! And A PLIER FOR EVERY JOB—(1) 7" duck bill plier; (2) 5" diagonal cutting plier; (3) 7" long needle nose and side cutter; (4) 6" side cutting plier. WHY BUY "GENERAL" PLIERS when XCELITE gives you just what you want? Ask your supplier for XCELITE!

Quality Tools PREFERRED BY EXPERTS

PARK METALWARE CO., INC.*
Dept. C, Orchard Park, N. Y.

* Originators of detachable screwdrivers, nut drivers and reamers.

LARGE CAPACITY SMALLEST SIZE



R.M.C. DISCAPS

Leading TV Makers Depend On Them

Type CC Miniature Ceramic High Frequency By Pass Series

1000 mmf and 1500 mmf DISCAPS measure only ¼" in diameter; 5000 mmf only 7/16" and 10,000 mmf 9/16". 600 V.D.C. working voltage—1200 V.D.C. test—3500 to 5000 V.D.C. breakdown.

LOW LEAKAGE • LOW SELF INDUCTANCE

Type CC DISCAPS are impervious to moisture, have a low temperature coefficient and good power factor. DISCAPS are definitely better.

SEND FOR DETAILS AND TEST SAMPLES

Radio Materials Corporation
1708 BELMONT AVE. CHICAGO 13, ILL.

A.R.C.'s VHF Communication and Navigation Equipment is a

REVELATION

Get static-free communication and the added reliability of omni range navigation with A.R.C.'s Type 17, 2-way VHF Communication and Type 15B Omni Range Navigation Equipment. With the 15B tuned to VHF omni stations, you fly directly in less time. You can receive weather broadcasts simultaneously with navigation signals **—static free!** It simplifies navigation and gives long, trouble-free life. The Type 17 adds an independent communication system for use while the 15B is providing navigational information. Installations for both single and multi-engined planes are made only by authorized agencies.

CLEAR COMMUNICATION ON VHF

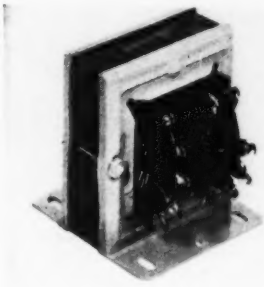
All A.R.C. airborne equipment is Type Certificated by CAA. It is designed for reliability and performance—not to meet a price. Write for further details or name of your nearest A.R.C. representative.

ARC
Aircraft Radio Corporation
BOONTON, NEW JERSEY

nitudes of sound pressures from remote terminals on the panel of the power supply unit. Sound pressures up to several million dynes per square centimeter may be directly measured over the 50 to 250-kc range. The output signal is delivered by a 25-ft. cable at an impedance level of 500 ohms.

Power Converters

RADIO PRODUCTS SALES, INC., 1501 South Hill St., Los Angeles 15, Calif. The RPS power conversion units combine a selenium rectifier with a matching transformer to convert d-c equipment into a-c use. The units are available to meet any



requirement in voltage and ampere ratings. Transformers are provided with four secondary voltage taps for adjusting d-c voltage for proper a-c input to the rectifier. Selenium rectifiers are of the full-wave bridge type and designed for continuous duty operation. A basic schematic is furnished with each unit.

A-C Bridge Measuring Unit

FREED TRANSFORMER CO., 1718 Weirfield St., Brooklyn 27, N. Y. The No. 1210 null detector and vtvm was designed for a-c bridge measurements. It provides simultaneous measurement of the voltage across the unknown and the balance of the bridge; sensitivity to 0.1, 1, 10 and 100 volts; and the input impedance

Take the headaches out of Fall production rush

Get trouble-free performance-smooth assembly-fast delivery

Today's engineering goes beyond just getting something that will work. In the hectic days ahead—days of volume production and extremely short delivery schedules on component parts—COMPONENTS MUST BE TROUBLE-FREE OR PRODUCTION LINES WILL STOP.

Alden hasn't been publication advertising recently, but has built up a whole series of products that are UNMATCHED for TROUBLE-FREE PERFORMANCE and QUICK DELIVERY. It holds a dominant position in kinescope socket assemblies. Its engineering has anticipated economic price trends. It is giving trouble-free performance on all kinds of speaker, hi-voltage, terminal and other connectors due primarily to the high standards of design calling for forward connected contacts that are trouble-free in production and service.

Go down through the list of items here—items unmatched for engineering, fast delivery and trouble-free performance.

FULL LINE OF CR CONNECTORS

211, 212, 214 — Full line of cathode ray tube connectors — magnal, duo decal, dt-heptal—meet highest standards for instrument work.

MINATURIZED SOCKET FOR 12 PRONG TV TUBES

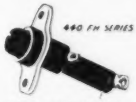
212MINC — Miniature duo-decal that incorporates forward connected contacts, individual strain relief for each lead—hi-voltage breakdown and 100% insulation for each lead.

MOLDED DUO DECAL SEGMENT

212-SC—Segment duo decal with same high engineering standards makes material and space savings.

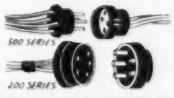
TINY, RUGGED MINATURIZED SEGMENT

212-SMINC — Miniature duo-decal segment absolute minimum of material and yet has complete safety—forward connected contacts give each lead individual strain relief and 100% insulation of leads.



FAST PRODUCTION MOUNTING FUSEHOLDERS

440FH — Complete line of fuseholders — provide for **noiseless** fused circuits—quick fuse ejection. Uses standard production tools—rivets, eyelets or spot welds to chassis. **New** improvements — coin slot knobs—miniaturized indicator fuseholders.



MULTIWIRE CONNECTORS WITH FORWARD CONNECTED CONTACTS ANY PURPOSE — LARGE OR MINATURE

200-500 — Engineers, production men and purchasing agents are now realizing that in our 200-500 series connectors they've got the only forward connected contacts that provide long protective insulation within the molding for each lead—that snubs the wire tip for insulation — and mechanically holds wire tips so it cannot be imperfectly soldered.

402AC — Convenience outlets with absolutely dependable contacts—that rivet or eyelet to chassis with no possibility of breakage—and using an absolute minimum of space below panel.

COMPACT, SPACE SAVING AC OUTLETS

202FRAC — Detachable line cords with sure grip plug — dependable snap-in connectors that take the smallest possible mounting space both above and below panel.

DETACHABLE LINE CORDS

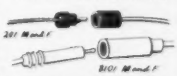
Non-int. 100, 200, 400 —Whole series of plugs and non-interchangeable bases for cables or plug in units (relays, coils, condensers, etc.). Strong stubby pins—no center boss to break—cannot be mistakenly plugged in tube socket—mate only with proper socket.

RUGGED PLUG IN BASES

90 Series—Every conceivable type of tube cap. Engineered to meet any requirements.

ALL TYPES TUBE CAPS

201M & F, 810M & F — Hi-voltage disconnects. 2000 VDC operating rating—bakelite housing forward connected contacts. 15000 VDC operating rating—low loss polyethylene with leads.

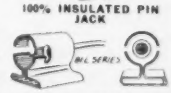


SAFETY ENGINEERED HI-VOLTAGE DISCONNECTS

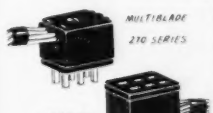
110BCS — Completely insulated pin jack providing easy constant checking point for circuits or tubes.

100% INSULATED PIN JACK

81L — Pilot light sockets—Rugged, dependable construction with the very minimum of parts and labor. Uses special Alden "center file" contacts — provides strain relief for each lead.



SIMPLEST, MOST RUGGED DIAL LIGHT SOCKETS



NEW, COMPACT MULTI-BLADE CONNECTORS

Here's our very latest development:

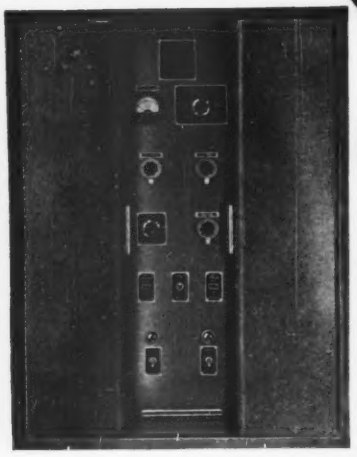
ALDEN MULTIBLADE CONNECTOR

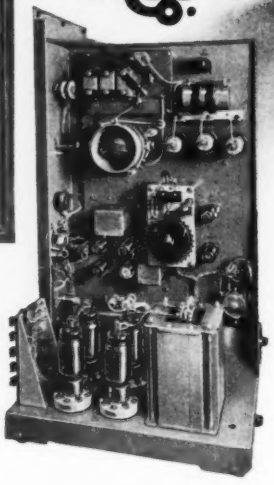
for the first time provides multiblades with forward connected contacts—which give long protective molded insulation around each leads — strain relief for each individual leads—rapid positive soldering. Completely housed in attractive molded colors.

Write, wire or phone for an immediate, thought-through response on any connector need.

ALDEN PRODUCTS COMPANY
BROCKTON 64E, MASS.

Introducing the TL-40C COMPASS LOCATOR TRANSMITTER by RR





...for instrument landing systems and short range navigation.

SPECIALLY designed for the standard CAA and ICAO instrument landing systems. Enables the pilot to navigate to the ILS and line himself up on the localizer. Also suitable for installation in any location where a low powered homing facility is required. Can be used to locate fan markers and other important reference points.

This transmitter is built for maximum accessibility. A feature of the equipment is simplified tuning, only two controls being required to tune the transmitter to the crystal frequency. Entire unit mounted on ball bearing wheels; can be rolled out of its cabinet on self-contained tracks. May be serviced from the front while in operation.

A separate antenna tuning unit is supplied with the transmitter. It is contained in a totally enclosed aluminum housing; designed for mounting on any vertical surface. Includes an antenna tuning control and a current meter on the front panel. 25 feet of Transmission line is supplied to connect the tuning unit to the transmitter.

Write for our New bulletin on the TL-40C
Address Dept. ES-9

Communications Division
RADIO RECEPTOR COMPANY, INC.
Since 1922 in Radio and Electronics
251 WEST 19th STREET • NEW YORK 11, N. Y.

is 50 megohms shunted by 20 $\mu\mu$f. Frequency range is 20 to 20,000 cycles. The null detector has a 94-db gain; selective circuits for 60, 400 and 1,000 cycles. Frequency range of the latter is 20 to 30,000 cycles.

Radioactivity Detector

INSTRUMENTS DIVISION, THE KELLEY-KOETT MFG. CO., 221 W. Fourth St., Covington, Ky. Designed and built exclusively for prospecting use, Model K-802 Prospector detects and measures beta and gamma rays emitted by uranium and other radioactive substances. Two stand-

ard flashlight batteries power the unit through a vibrator power supply which furnishes the high voltage for the Geiger tube. Practically any magnetic type single or double phones having 1,000 to 24,000 ohms impedance can be used with the instrument. Further details may be found in bulletin E-5.

Isolation Amplifier

AIRCRAFT RADIO CORP., Boonton, N. J. Type F-11 isolation amplifier for aircraft use makes it possible for pilot or copilot to select any

combination of 10 receivers, sidetone or interphones with complete independence of each other's choice. It also provides loudspeaker operation to both pilot and copilot. Weight is 8.3 pounds.

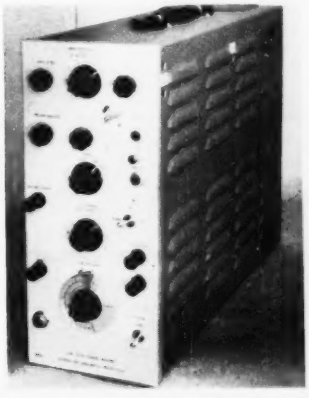
Midget-Can Electrolytics

AEROVOX CORP., New Bedford, Mass. The latest type PRS Dandee midget-can electrolytic capacitor illustrated measures 13/16 in. in diameter by 1¼ in. long. These smaller

electrolytics are available in single-section ratings from 25 to 700 volts d-c, 4 to 100 μf; dual-section units, from 25 to 450 volts, 8–8 to 100–100 μf.

Direct-Coupled Amplifier

TEKTRONIX INC., 712 S. E. Hawthorne Blvd., Portland 14, Oregon. The Type 112 direct-coupled amplifier has a bandwidth from d-c to 1 mc when used at a maximum voltage gain of 5,000. For voltage gain requirements of 166 and less the bandwidth extends to 2 mc. An output of approximately 150 volts



100,000 QUESTION MARKS ... were put to work!

by the successful design and production of Elinco instrument-type fractional h.p. motors and generators that met special needs.

Yes, every finished Elinco motor or generator was born of a question mark. There was a job to be done . . . could Elinco engineer and produce a special unit to do the job? The answer is in the over 100,000 special Elinco units, successfully designed to the most exacting specifications, and now serving in practically every type and branch of industry. Special design is our business . . . not low-cost, mass-production motors . . . but special high-precision instruments demanding the highest engineering ability, and exceptional manufacturing skill and care.

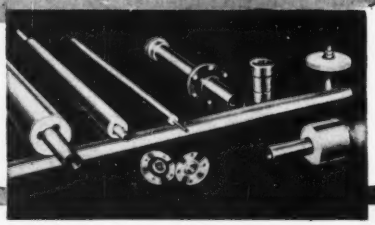
there are over 400 Basic Models of Elinco Fractional H. P. Instrument-Type Motors and Generators

Units are produced to order, either by the design of a new model to meet your exact requirements, or by the adaptation of one of our over 400 basic units in order to meet your needs, either electrically or physically.

ELECTRIC INDICATOR CO.
PARKER AVENUE, STAMFORD, CONN.

wave guide & coaxial assemblies

- RAPID INSTALLATION
- HIGH EFFICIENCY
- UNIFORM IMPEDANCE
- COMPLETE LINE OF FITTINGS



GENERAL

Transmission line in all types including standard RMA sizes for FM and TV

GENERAL CERAMICS Transmission Lines are available in sizes to meet any installation requirement. All lines are of the bead supported type, in standard lengths. Fabrication to close tolerance assures highest efficiency. Special "clover leaf" spacer beads effectively reduce capacity effects and arcing. Carefully designed end seals assure permanently gas-tight terminations. Pressurizing equipment, including gauges, valves, etc., impedance matching units, wave guide and coaxial assemblies for antennae and R.F. sections are supplied to exact requirements.

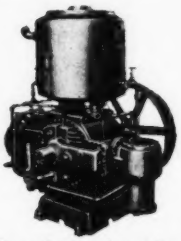
Our engineers are always pleased to check any project and furnish quotations.

General CERAMICS and STEATITE CORP.

GENERAL OFFICES and PLANT: 22 CROW'S MILL ROAD, KEASBEY, N. J.

MAKERS OF STEATITE, FERRAMIC, ZIRCON, PORCELAIN, LIGHT DUTY REFRACTORIES AND CHEMICAL EQUIPMENT

here's help for HIGH VACUUM problems



Beach-Russ Type RP Single Stage Vacuum Pump. Capacity—17 to 845 c.f.m.

For vacuum exhausting and processing at low pressures in electronic or electrical operations, these pumps offer the advantages of positive rotary, automatically lubricated, noiseless operation. They are "tops" for producing high vacuum or for backing diffusion pumps. Test to absolute pressures as low as 4 microns.

BEACH-RUSS *high vacuum* **PUMPS**

Write for Catalog No. 84

BEACH-RUSS COMPANY
52 Church St. New York 7, N. Y.

MEPCO PRECISION RESISTORS

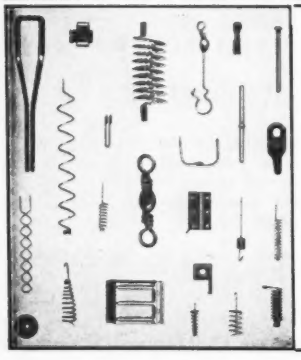
Quality wire wound resistors for government and commercial equipment.

JAN R-93 JAN R-29

• *Write for new bulletin giving electrical and mechanical specifications.*

MEPCO, INC.
37 Abbett Avenue
Morristown, N. J.

Telephone: Morristown 4-5777



SMALL PARTS

Filaments, anodes, supports, springs, etc. for electronic tubes. Small wire and flat metal formed parts to your prints for your assemblies. Double pointed pins. Wire straightened and cut diameter up to ⅛-inch. Any length up to 12 feet.
LUXON fishing tackle accessories.
Inquiries will receive prompt attention.

ART WIRE AND STAMPING CO.
227 High St. Newark 2, N. J.

SPECIALTY DRY BATTERIES

Custom Built To Exacting Industrial and Electronic Requirements

Looking for a dry battery that's odd sized or with unusual capacity or lasting power? Specialty Battery Company makes special batteries for every conceivable purpose. Send us your specifications. We can fill your needs from our stock or manufacture a battery to your specifications.

Write For Catalog

Gives complete descriptions of hard-to-get industrial, laboratory, radio and ignition batteries.

SPECIALTY BATTERY COMPANY
A Ray-O-Vac Subsidiary
RAY-O-VAC
MADISON 3, WISCONSIN

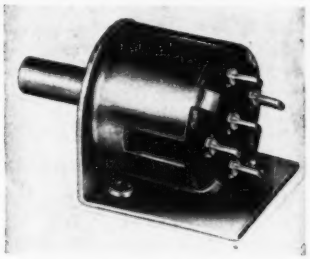
peak-to-peak is available to a high impedance load such as crt deflection plates. A 1-kc square-wave calibrating voltage from 0 to 50 volts is available by a 9-position range switch in conjunction with a calibrated potentiometer providing an accuracy of ± 5 percent.

Insulating Varnish

IRVINGTON VARNISH & INSULATOR Co., Irvington 11, N. J. Harvel 1012C is an internal-curing insulating varnish developed particularly for the impregnation of wound structures requiring the maximum of mechanical bonding strength. The varnish cures rapidly and the cured film is oil-proof. At its shipping consistency the varnish will produce a film thickness of approximately 0.0025 inch.

Four-Way Switch

GUARDIAN ELECTRIC MFG. CO., 1621 W. Walnut St., Chicago 21, Ill. Designed primarily to control trim tabs on jet airplanes, this compact four-way switch is applicable wherever control of four separate circuits at one compact central switch is required. Changes are



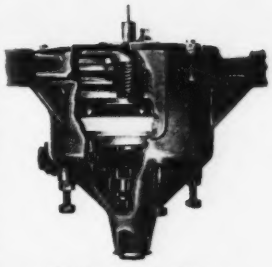
made directly from one "on" position to another 90 degrees apart, with center position "off." The unit is designed to control 3 amperes, 28 volts, d-c.

Matching Transformers

POLYTECHNIC RESEARCH AND DEVELOPMENT CO., INC., 202 Tillary St., Brooklyn 1, N. Y., has developed a series of E/H tuners of the type illustrated providing coverage of the 12.4 to 40 kmc band. These matching transformers consist of hybrid tee junctions in which mova-

WHY CHOOSE FAIRCHILD FOR TOP PERFORMANCE

Each month you read equipment specifications in the advertising pages of your favorite magazines. Specifications are fine things, but often difficult to interpret in terms of *what the equipment will do for you.* For example, suppose we say that **Fairchild Disk Recorders and Transcription Turntables** have a time accuracy of 1 part in 4.6×10^6 at 33⅓ rpm; an instantaneous speed deviation of .075%; a noise level of such and such decibels below some stylus velocity at so many cps. Impressive? Sure. And factual, too. But what you want to know is . . . what effect do these specs have on your operations. What is the performance, after the specifications are paid for? Here are the data on Fairchild Recording and Playback equipment, in facts and effects.



Precision Turntable Drive. Used in all Fairchild Disk Equipment.

FEATURE	FAIRCHILD EQUIPMENT	OTHER DESIGNS
Type of Drive and Resultant Speed Regulation	Direct to center—gear. Absolute synchronism for use with sound-on-film and on the nose programming. Accurate within .00026 seconds in 20 minute play period at 33⅓ rpm.	Rim drive—puck or pulley. Usual accuracy—6 seconds in 20 minute play period (.5 % speed regulation). Does not permit rigid synchronization nor on the nose programming.
Possible time error—record and playback (20 minute disk)	± .00052 seconds	± 12 seconds (based on above)
Instantaneous speed deviation and Effect on audible signal	less than .075 % None	approximately .125 % *Wow* usually evident at this figure
Noise and Rumble	Experienced users of Fairchild Equipment claim dynamic range of 62 db.	Dynamic range limited by noise and rumble when wide tolerances are permitted in machining.
Control of cutting pitch (lines per inch)	Studio model: turn knob for *continuous* and *instantaneous* pitch change from 80 to over 500 lines per inch. Can be varied at will during the recording. Portable model: insert small gear—no disassembly required—only one feed screw for all pitches.	Portable and Studio models: disassemble lathe mechanism—change feed screw—reassemble lathe mechanism. Or, change pulley ratios.
Overhead cutter assembly	Secured as integral part of turntable deck. Always in positive alignment.	Lift or swing into position. Possibility of cutter misalignment—causing varying depth of cut and incorrect groove shape.
Portable model	Actually a console model in a portable case. Same performance on location as in the studio.	Sacrifices in mechanical design to gain portability further exaggerate inferior performance.
Maintenance	Periodic lubrication of drive mechanism. Always at peak performance—no headache for the owner and operator.	Lubrication, and frequent replacement of puck and pulleys. Continued adjustment necessary to keep speed of turntable up to specifications.

Fairchild specializes in LIP SYNCHRONOUS recording and playback equipment for SOUND-ON-FILM, TV PRODUCTIONS, and all such installations requiring laboratory standard performance. Write for full details.

Fairchild
RECORDING EQUIPMENT CORPORATION
154TH ST. AND 7TH AVE. WHITESTONE, L. I., N. Y.

An Important Statement
by
MYCALEX CORP. OF AMERICA

Issued in an effort to clear up and to avoid continued confusion

It has come to our attention that some electronic engineers and purchasing executives are under the erroneous impression that the MYCALEX CORPORATION OF AMERICA is connected or affiliated with others manufacturing glass-bonded mica insulation under other trade names, and that genuine "MYCALEX" and glass-bonded mica insulation made by such other companies are "all the same thing" . . . are "put out by the same people", . . . and "come from the same plant". NONE OF THIS IS TRUE.

THE FACTS ARE:

1. The MYCALEX CORPORATION OF AMERICA is not connected or affiliated with any other firm or corporation manufacturing glass-bonded mica insulation materials, except Mycalex Products Sales Corporation and Mycalex Tube Socket Corporation, which are exclusively licensed by the Mycalex Corporation of America to distribute and sell Mycalex components. These "Mycalex" companies are 100% American in ownership.

2. The word "MYCALEX" is not a generic term. It is a trade-mark registered in the United States Patent Office, and owned by the MYCALEX CORPORATION OF AMERICA, and identifies the glass-bonded mica insulation products of formulae and design developed and manufactured in the plant of the MYCALEX CORPORATION OF AMERICA.

3. The General Electric Company, by virtue of a non-exclusive license it had under a MYCALEX patent through the MYCALEX COMPANY, LTD., of Great Britain, has been permitted to identify its glass-bonded mica insulating materials made under such license as "G-E Mycalex".

4. The MYCALEX CORPORATION OF AMERICA has behind it over 30 years of research leadership and owns U. S. patents and patent applications on improved glass-bonded mica insulation marketed under the trademarks "MYCALEX", "MYCALEX 410", "MYCALEX 410X", "MYCALEX 400", and "MYCALEX K".

5. All products of the MYCALEX CORPORATION OF AMERICA are given distinctive identifications incorporating the trade-marked name "Mycalex"; all such identifications are registered and may be legally used only by the MYCALEX CORPORATION OF AMERICA and those authorized by it.

MYCALEX 410 is the most versatile and nearly perfect insulation material yet developed for the electronics industry. Widely specified because of its low dielectric loss, high dielectric strength, high arc resistance, dimensional stability over wide humidity and temperature changes, resistance to high temperatures, mechanical precision, mechanical strength, and ability to be molded, with or without metal inserts, to extremely close tolerances and in irregular shapes. Priced to compete with less effective electrical insulation materials such as mica-filled phenolics, steatite, etc.

MYCALEX 410X (leadless formulation), can be injection molded, with or without metal inserts, to extremely close tolerances. Equal in versatility to MYCALEX 410, and used where somewhat lesser dielectric qualities are acceptable. Priced to compete with general purpose phenolics.

MYCALEX 400, fully approved by the Army and Navy as Grade L-4 insulation, is a low-loss Mycalex insulation—available in sheets and rods, and can be machined to size, shape and specifications.

MYCALEX K is a series of capacitor dielectrics that can be supplied in sheets, rods and molded parts, to special order.

6. "MYCALEX" in all the forms described above, is made by exclusive formulae and exclusive patented processes. It is impossible for anyone other than the MYCALEX CORPORATION OF AMERICA to supply any product, similar in appearance, as the very same thing.

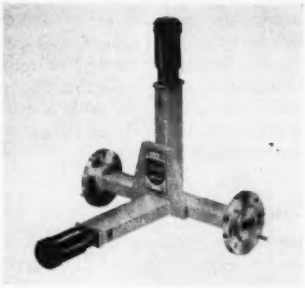
MYCALEX STANDS ON ITS OWN REPUTATION

MYCALEX CORP. OF AMERICA

SINCE 1919 MYCALEX THE INSULATOR

"Owners of 'MYCALEX' Patents"

Plant and General Offices: Clifton, N. J. Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.



ble choke-type shorts are placed in the shunt and series arms. By proper adjustment it is possible to reduce to a value less than 1.02 a vswr as high as 20 to 1 and of arbitrary phase.

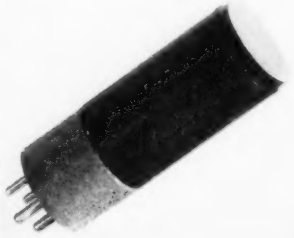
UHF Crystals

CLARK CRYSTAL CO., Marlboro, Mass., announces two new crystal units in the 90-kc to 100-mc range. The HSM-2 is designed to operate into a load capacitance of 32 μμf on the fundamental frequency. Type

HSM-2H is designed to operate at series resonance on odd harmonics of the fundamental. The two are part of a complete line described in bulletin 4AC.

Radiation Counter Tubes

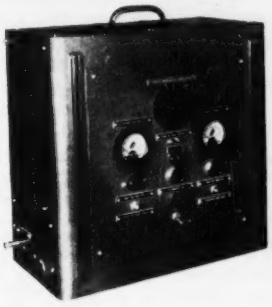
AMPEREX ELECTRONIC CORP., 25 Washington St., Brooklyn 1, N. Y., announce that their end mica-window radiation counter tube types 100C, 100N, 200C and 200N are now available in standard medium 4-pin bases for socket mount-



ing. They can be had in either the regular construction or the new 4-pin base.

Reversible-Polarity Power Supply

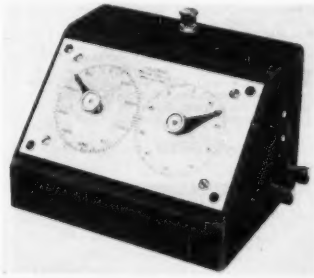
BETA ELECTRIC CORP., 1762 Third Ave., New York 29, N. Y., announces the Model 203 portable d-c reversible-polarity power supply. By changing two leads, high voltage can be made either positive or negative with respect to ground. The



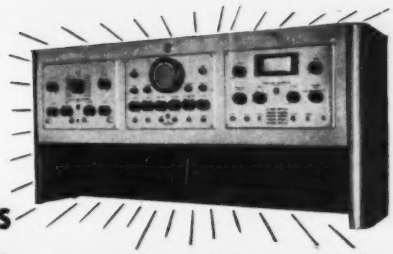
power supply operates on an input of 117 volts, 50 or 60 cycles, 225 volt-amperes maximum. Output voltage is continuously variable from 0 to 30 kv d-c; output current, 2 ma maximum, approximately 300 μa at 30 kv.

Mechanical-Cycle Control

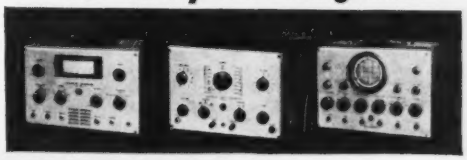
CYCLOTRON SPECIALTIES CO., Moraga, Calif. By means of two calibrated dials the Cyclo-Trol register can be instantly set to any number from 0 to 10,000. When a cycle is completed the unit can be returned to the original setting by pressing a button, so that specified cycles may be repeated any number of times



Choose packaged test equipment with *matched* units —for every servicing need

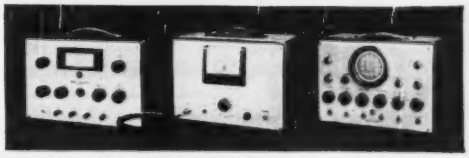


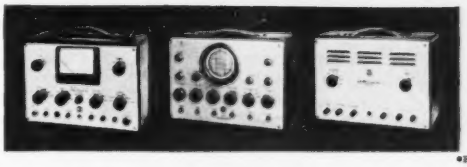
FOR TV SERVICING
WR-39A Television Calibrator
WR-59A TV Sweep Generator
WO-55A Oscilloscope



FOR AM-FM SERVICING
WR-53A FM Sweep Generator
WR-67A Test Oscillator
WO-55A Oscilloscope

FOR SOUND (Public Address)
WA-54A Audio Oscillator
WV-73A Audio Voltmeter
WO-55A Oscilloscope





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WV-95A Master VoltOhmyst*
WO-55A Oscilloscope
WP-23A Regulated Power Supply

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Where mounting of any RCA matched test instrument in a standard 19-inch relay rack is desired, the WS-18A Rack Adapter Panel is available on separate order.

For full details and technical specifications on the rack and the nine instruments, ask your RCA Test and Measuring Equipment Distributor for Bulletin 2F719—or write RCA, Commercial Engineering, Section 42KY, Harrison, N. J.

Available from your RCA Test and Measuring Equipment Distributor

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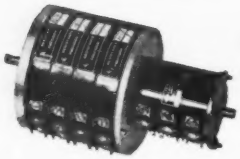
CUSTOM-BUILT



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Typical of the solutions to special precision potentiometer problems submitted to Fairchild engineers by our customers is this custom-built combination of standard parts. It combines the extremely high resolution, fine linearity, and large electrical angle of the 4-gang Type 748 linear windings (left) with the flexibility, high accuracy, and small size of the 3-gang Type 736 non-linear potentiometer.

Through our policy of custom-manufacturing these instruments to your order, the services of our Potentiometer Sample Laboratory engineers are available for the analysis of all special precision potentiometer applications submitted to us. Sample deliveries are currently on a 3-week basis. Send us your precision potentiometer problems. For descriptive literature address: Dept. M, 88-06 Van Wyck Boulevard, Jamaica 1, New York.

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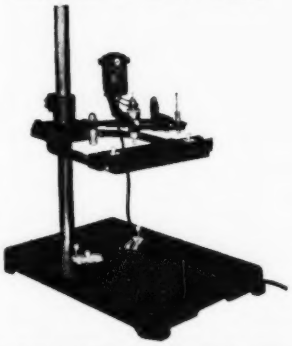
—MICO— ENGRAVER

Model 253 For LARGE PANELS



A further adaptation of the already proven model 252 Mico Engraver. Permits accurate engraving on metal or plastic panels up to 19 inches wide and of unlimited length. Maximum height of work above table, 19 inches. Micrometer spindle and four reduction ratios are standard equipment.

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without resetting the dials. Ideal for coil winding machines, the instrument also handles counting problems with precise control over any number of revolutions or cycles up to 10,000, with a counting rate of up to 60 impulses per second.

Literature

Rectangular Coordinate Recorder. Airborne Instruments Laboratory, Inc., 160 Old Country Road, Mineola, N. Y. An 8-page brochure covers the type 373 high-speed rectangular coordinate recorder. The system described plots voltage, or the logarithm of voltage, as a function of time or of the displacement angle of a measured element.

Tube Information. Radio Corp. of America, Harrison, N. J. Two recent bulletins contain technical information on the type 5819 multiplier phototube for use in scintillation counters, and the 5820 image orthicon for television cameras. Installation and application data, circuit diagrams, characteristics and socket connections are included.

Solderless Wiring. Aircraft-Marine Products Inc., 1523 N. Fourth St., Harrisburg, Pa., has issued a well-illustrated pocket catalog on solderless wiring to provide a quick analysis of the various types of solderless terminals and the applications for which they are best suited. Also available is an 8-page reprinted article on the subject.

Signal Calibrator. Industrial Electronics, Inc., 2457 Woodward Ave., Detroit 1, Mich., has issued a leaflet introducing the Electro-Cal, a signal calibrator for precision laboratory measurements, which covers 0 to 1,000 mv in eight continuously variable ranges. Information concerning the company's service provided to manufacturers of electronic instruments is also available on request.

Beam Antennas. U.H.F. Resonator Co., Guion Road, Rye, N. Y., has available four folders describing

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When you find your records sounding fuzzy and worn after a few playings, in spite of the most modern equipment . . .
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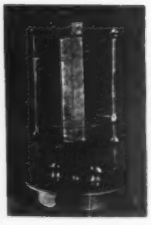
New James Knights Co. Catalog On Request



A tube research laboratory needed a 19 kc crystal to use as a standard. The James Knights Company delivered one in a hurry. A partially assembled H18T hermetically sealed unit on 19 kc is shown at the left. The James Knights Company does many kinds of special work for exacting customers every day.

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and illustrating the following antenna types respectively: (1) super-high gain, semi-professional, multielement f-m and television beams; (2) the 8-element 10-meter beam; (3) improved vertical and horizontal 16 and 32-element two-meter beams; and (4) high-forward-gain beam antennas for the amateur bands.

Power Oscillator. Airborne Instruments Laboratory, Inc., 160 Old Country Road, Mineola, N. Y., has available a 4-page folder describing and illustrating the type 124A power oscillator. The instrument treated consists of a grid separation coaxial oscillator employing a 2C38 disc seal triode, an audio oscillator and modulator section and a self-contained rectifier power supply.

Regulated Power Supplies. Lambda Electronics Corp., 103-02 Northern Blvd., Corona, N. Y. A small booklet contains a description and specifications of models 25 and 28 regulated power supplies which are functionally designed for use in industry, laboratory, radio station and school to supply stable power to electronic and other equipment.

Resistors. Resistance Products Co., 714 Race St., Harrisburg, Pa., has issued a booklet on wire-wound precision, high-voltage, high-frequency and high-resistance units. Engineering data and complete technical description are given.

Shaded-Pole Motors. Russell Electric Co., 4501 South Western Blvd., Chicago 9, Ill. Two recent 4-page bulletins give a complete description of two types of two-pole, skeleton frame, shaded-pole induction motors. Bulletin 2000 covers the type 350, with ratings of 1/10 and 1/15 hp; bulletin 1000 describes the type 230 with ratings from 1/50 to 1/200 hp. Both motors described have a load speed of 3,000 rpm.

Vibration Isolators. Finn & Co., 2850 Eighth Ave., New York 30, N. Y. A new 24-page catalog gives latest information on a complete

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line of vibration isolators. This reference book contains specification charts for the easy selection of the right isolators for various types of machinery. Also included is a comprehensive treatment of the theory of isolation and shock.

Mercury Switches. Minneapolis-Honeywell Regulator Co., Wayne & Roberts Aves., Philadelphia 44, Pa. The two basic types of a line of switches described in catalog 1343 are mercury-to-electrode and mercury-to-mercury. Their manufacture and testing are shown and typical applications outlined. Several pages of engineering data and selection tables, as well as complete switch specification charts, are presented.

General Catalog. Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill., announces publication of its new 1950, 196-page catalog covering "Everything in Radio and Electronics." Special emphasis has been placed on equipment for industrial maintenance, research and production requirements. The new catalog is available without charge.

Receiving Tube Data. Sylvania Electric Products Inc., Emporium, Pa., has published a revised edition of a comprehensive technical manual containing basic application data for 637 radio receiving tube types and c-r tubes used by circuit designers, radio and television set repairmen and industrial electronic engineers. The 418-page manual is priced at 85 cents per copy.

Precision Resistors. Mepco, Inc., 37 Abbett Ave., Morristown, N. J. A new catalog describes a line of precision wire-wound resistors. The basic feature is its condensed form thereby affording ready reference to all type resistors either under JAN R-93 or commercial specifications. The JAN R-29 meter multiplier is also covered.

Bi-Metal Thermostats. Stevens Mfg. Co., Inc., Mansfield, Ohio. Bulletin F-2002 describes and illustrates the type C standard and hermetically sealed bi-metal strip thermostats which give the temperature stability required by com-

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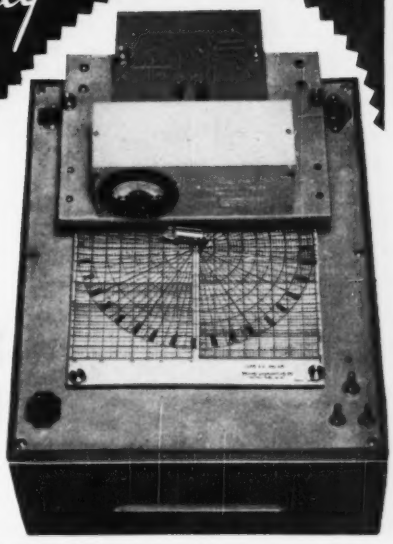

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These Choppers convert low level DC into pulsating DC or AC so that servo-mechanism error voltages and the output of thermocouples and strain gauges, may be amplified by means of an AC rather than a DC amplifier.

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Catalog 267
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munications equipment, electronic devices and other types of electrical apparatus. The bulletin contains a schematic drawing of operating principle and a typical response curve of these units.

Miniature Cell. Muirhead & Co. Ltd., Elmers End, Beckenham, Kent, England. Bulletin B-638-A describes and illustrates the type D-550-A miniature standard cell which features an internal resistance of approximately 750 ohms at 20 deg C. Technical specifications, mechanical construction and mounting details are given.

Photoelectric Cells. The International Rectifier Corp., 6809 So. Victoria Ave., Los Angeles 43, Calif., has published bulletin PC-649 covering its new line of selenium self-generating photoelectric cells. It contains diagrams and curves describing the construction, performance characteristics and applications of the cells. A price list is also included.

Research Services. Cook Research Laboratories, 1457 Diversey Parkway, Chicago 14, Ill. A 42-page brochure, No. B-2, describes the research services, personnel and facilities available to government agencies and private industry on a contract basis. Photographic views of the laboratory's physical facilities are shown along with illustrations of newly developed electronic instrumentation equipment. A request on business letterhead will obtain a copy of the brochure.

R-F Power Amplifier. Tung-Sol Lamp Works, Inc., Newark 4, N. J. A single-sheet bulletin covers the type 5A6, a miniature 3-watt filamentary-type pentode r-f power amplifier. The tube described was designed for equipment in the 25-to-50 and 72-to-76-mc bands.

Aircraft Equipment. Lear, Inc., 110 Ionia Ave. N. W., Grand Rapids 2, Mich. A four-page brochure describes in pictorial detail a line of vhf navigating and communication equipment with suggested system combinations to meet the needs and increase operational safety of individual plane owners.

THE NEW *Improved*
MODEL 3HW-A
Workshop Antenna
will . . .

More than triple the effective power of the transmitter.

Increase the effective power of the mobile transmitter.

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Permit the use of low power, low cost equipment.

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Studs extend full length of springs for added support. High grade nickel plated brass screw machine parts with accurate threads and milled nuts.

All plugs can be furnished with nickel, cadmium or silver plating if required.

JOHNSON also manufactures spring sleeve types, removable round head tip jacks, molded round head tip jacks, insulated combination jacks, metal head tip jacks, twin tip jacks and shorting type twin tip jacks.

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The All-Weather Resistors

ARE USED IN THIS ULTRA SENSITIVE ELECTRONIC PHOTOMETER

In this instrument—designed for measurement of very low light values—S.S.White Resistors serve as the grid resistance in the all-important high-gain D.C. amplifier circuit. The manufacturer, Photovolt Corp., New York, N. Y., reports that the resistors "work very satisfactorily"—which checks with the experience of the many other electronic equipment manufacturers who use S.S.White resistors.

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are of particular interest to all who need resistors with inherent *low noise level* and *good stability* in all climates.
HIGH VALUE RANGE
10 to 10,000,000 MEGOHMS
STANDARD RANGE
1000 OHMS to 9 MEGOHMS

WRITE FOR BULLETIN 4506

It gives essential data about S.S.White Resistors, including construction, characteristics, dimensions, etc. Copy with price list on request.

Photo courtesy of Photovolt Corp., New York, N. Y.

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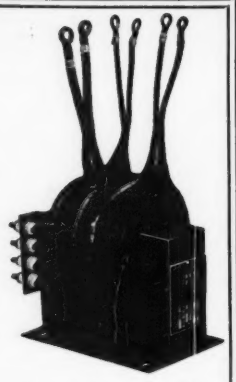
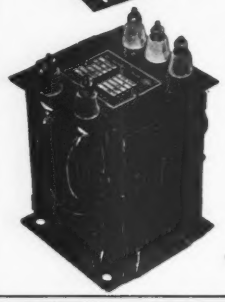
NWL





Over 25 years' experience in the manufacture of specials at cost that compares favorably with standard types. Built in quality proved by years of actual use.

From 10VA to 300 KVA Dry-Type only. Both Open and Encased. 1, 2, and 3 Phase. 15 to 400 Cycles.

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NEMA

IS YOUR PROBLEM

COUNTING OR CONTROLLING

ONE OF THESE?

QUANTITY—Pills, buttons, bottle caps, hardware, etc., can be counted and batched in precise predetermined quantities at speeds up to 15,000 per minute. Important savings in labor and overages are assured by the speed and accuracy of the Potter Electronic Counter. Count Detectors for any product are available.

LENGTH—Wire or strip material can be automatically sheared or marked in precise predetermined lengths at high rates of speed, and if required, automatically stacked in predetermined quantities. Practically any definition of measurement can be obtained.

TIME—Time intervals can be easily measured or generated with extremely high accuracy through the use of Potter Counter Chronograph Interval Timers. Registration of measurement is retained until reset. Accuracy of one part in 1,600,000 can be provided.

CAM SEQUENCE—Since the electronic counters can be arranged to predetermine any sequence of selected counts, they can be readily and advantageously substituted for cams, gears, patterns, chains and other systems of timing control. Control by absolute count assures high accuracy, faster operating speeds, since there are no moving parts to wear.

FREQUENCY—Potter Electronic Counters provide an exact ratio of division which is maintained even though the input frequency is varied. If the input frequency is stopped the output also stops. Frequencies can be measured or generated with high precision. Square waves of variable frequency, pulse-width and number can be easily generated.

REVOLUTION—Through electromagnetic or photoelectric pickup, shaft rotation can be accurately counted or timed without physical contact. Fractional parts of a revolution can be measured or used to control automatic machine processes as a function of predetermined counts.

– then COUNT on a

POTTER

High-Speed Predetermined

ELECTRONIC COUNTER

For appraisal of your counting, timing or control problem, address inquiries to Dept. 6-J. Potter Instrument Company, 136-56 Roosevelt Ave., Flushing, New York.

mittee includes the following: J. Dorfman, W. C. Hagey, B. Hecht, R. M. Krueger, H. E. May, R. F. Rollman, J. R. Steen, H. Walker and V. Wouk.

The newly formed committee shall sponsor a full session at the Radio Fall Meeting, to be held in Syracuse, N. Y., on October 31, November 1, and 2. Three papers will be presented at this panel.

Antenna Lecture Series

A SERIES of lectures on contemporary developments in antennas and their engineering design is now being presented jointly by the New York Section of the IRE and AIEE on Tuesday evenings at 7 o'clock in the Engineering Societies Building, 33 West 39th St., New York City. The remaining lectures are as follows:

Oct. 25—Fundamental Considerations of Transmitting Antennas for TV and F-M Broadcasting, by A. G. Kandoian of Federal Telecommunication Laboratories.

Nov. 1—Special Problems in TV Transmitting and Receiving Antennas for UHF and VHF, by A. Alford of Andrew Alford Consulting Engineers.

Nov. 15—Omnidirective Antennas for Vertical and Horizontal Polarization, by H. A. Wheeler of Wheeler Laboratories.

Nov. 22—Antennas for High Speed Aircraft by J. F. Byrne of Airborne Instrument Laboratories.

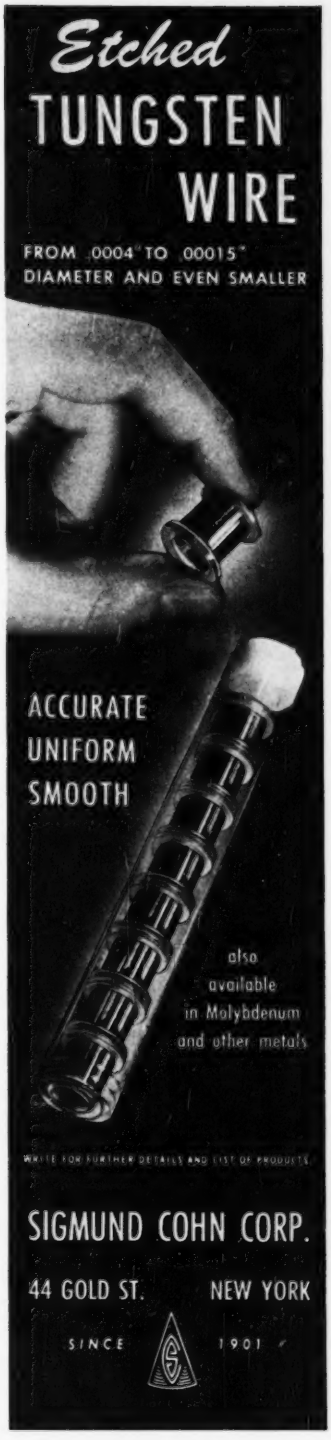
Nov. 29—Lenses, Reflectors and Superdirectivity, by W. I. Kock of Bell Telephone Laboratories.

Tuition fees for single lectures are $1 for members and $2 for nonmembers. Single session registration is accepted at the door.

USAF Investigates Upper Atmosphere

A TWO-YEAR research program investigating the composition of the atmosphere at altitudes up to 75 miles above the earth was recently inaugurated by the U. S. Air Force at Holloman Air Force Base, Alamogordo, New Mexico. Sixty Navy-developed Aerobee rockets are being used in the investigation.

Electronic recording instruments



will be placed in special compartments of the 20-ft-long Aerobees by 30 different U. S. colleges or research institutions during the program. Instrumentation of the rockets and evaluation of collected data will be carried out by each individual organization under contractual agreements with the Air Force.

When all data from the research program has been evaluated it will be used by the Air Force in evolving the design of guided missiles, in determining the relation between solar activity and weather changes, and as basic atmospheric information to be used in the guided missiles program.

Audio Engineers' Fall Lecture Series

THE AUDIO Engineering Society has scheduled a series of 16 weekly lectures from Nov. 10, 1949 to Feb. 23, 1950, on the elements and practices of sound recording. Lectures will be given at Steinway Hall, 113 W. 57th St., New York, N. Y., at 7:15 P. M. on the dates assigned. The program is as follows:

Nov. 10—Psychoacoustical Aspects of the Recording Problem, by H. F. Olson of RCA Laboratories, Inc., and W. B. Snow of the Kellex Corp.

Nov. 17—The Recording Process—A Survey, by C. J. LeBel of Audio Instrument Co., and C. R. Sawyer of Western Electric Co.

Nov. 22—Disc Recording—Equipment, by T. Lindenberg of Fairchild Recording Equipment Corp., and N. C. Pickering of Pickering & Co., Inc.

Dec. 1—Disc Recording—Theory, by E. Cook of Cook Laboratories and H. E. Roys of RCA Victor.

Dec. 8—Disc Recording—Test Procedures & Processing, by F. W. Roberts of Dictaphone Corp., and K. R. Smith of K. R. Smith Co., Inc.

Dec. 15—Magnetic Recording—Equipment & Circuits, by P. M. Brubaker of Rangertone, Inc.

Dec. 22—Magnetic Recording—Theory, by L. C. Holmes of Stromberg-Carlson Co., and R. E. Zenner of Armour Research Foundation.

Dec. 29 — Magnetic Recording — Test Procedures, by P. Fish of Columbia Broadcasting System, Inc.

Jan. 5—Film Recording—Equipment, by W. J. Albersheim of Bell Telephone Laboratories, Inc., and W. H. Offenhauser of Cornell U. Medical College.

Jan. 12 — Film Recording — Optical Fundamentals, by J. A. Maurer of J. A. Maurer, Inc., and L. T. Sachtleben of RCA Victor.

Jan. 19—Film Recording—Light Controls & Noise Reduction Systems, by C. Keith of Western Electric Co., and E. Miller of RCA Victor.

Jan. 26—Film Recording—Film Characteristics, Developing & Printing.

Feb. 2—Film Recording—Test Procedures, by G. Lewin of Signal Corps Photographic Center, and E. S. Seeley of Altec Service Corp.

Feb. 9—Microphone Placement & Studio Acoustical Requirements.

Feb. 16—Speech Input Systems, Monitoring Philosophies & Methods.

Feb. 23—The Recording System—Layout.

New WELLER 250-watt Soldering Gun

Heavy jobs and light jobs—the new 250-watt Weller Soldering Gun speeds them all. Chisel-shaped RIGID-TIP provides more soldering area for faster heat transfer. New "over-and-under" terminal design gives bracing action to tip. Your Weller Gun does delicate or heavy soldering with equal efficiency; compact and lightweight, it gets into the tightest spots.

Weller Guns actually pay for themselves in a few months. Fast 5 second heating means no time lost. Trigger-switch control means no current wasted —no need to unplug gun between jobs. Prefocused spotlight and longer length let you *see* the job and *reach* the job with ease. No other soldering tool offers so many time-and-money-saving features. Order your new 250-watt Weller Gun from your distributor today, or write for bulletin direct.

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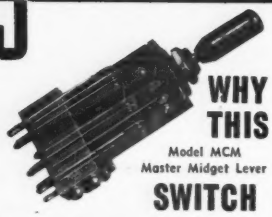
5 REASONS WHY THIS SWITCH Aids Electronic Designs



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1 ▶ **It's adaptable**
It gangs enough contact arrangements to handle nearly every circuit change you can conceive.

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Small enough to fit in the tightest spots, it extends only 2¼ inches behind the panel and weighs but 3½ ounces complete with 12 springs.

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Each detent action is fixed by patented stainless steel inserts; full throw in non-lock as well as in locking action.

4 ▶ **It's dependable**
Contacts handle 5 to 10 amperes at 115 volts a-c, depending on load characteristics; tested at 2500 volts a-c to ground.

5 ▶ **It's convenient**
Single-hole mounting; contact assemblies are detachable for easy wiring. Alternate actuating means suit varied installation

requirements—waterproof handle (A) for marine use, rotary actuator (B) and lever arm (C) permit switch mounting parallel to panel.

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New Sub-midget Model MCT Switch provides convenience, adaptability, and dependability in minimum space. Ask for bulletin.

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Re-Recording, Maintenance, by R. A. Schlegel of WOR Recording Studios, and E. S. Sorensen of Columbia Records, Inc.

Subscription for the course is $16.00 to members and applicants; for single lectures, $2.00 each. To non-members, the course subscription is $24.00; single lectures, $3.00. Tickets are available from F. Sumner Hall, Course Chairman, 153 W. 33rd St., New York 1, N. Y.

BUSINESS NEWS

THE HELIPOT CORP., potentiometer manufacturers, recently moved into their block-square new building at 916 Meridian Ave., South Pasadena, Calif.

ALLIS CHALMERS, Milwaukee, Wisc., recently completed building and installation of a 22- million- volt push-button- controlled betatron which is now treating cancer patients at the University of Illinois College of Medicine, Chicago, Ill.

VOICE AND VISION, INC., designers and installers of built-in television and radio for the home, have moved into their new quarters at 314 North Michigan Ave., Chicago, Ill.

PLANET MFG. CORP., Bloomfield, N. J., is a new company organized for the manufacture of dry electrolytic capacitors.

UNIVERSAL MOULDED PRODUCTS CORP., Philadelphia, Pa., will expand its activities into the electronic field through the media of products developed by International Electronics Co., also of Philadelphia.

JFD MFG. CO., radio equipment manufacturers, have moved into a new and enlarged plant at 6101 16th Ave., Brooklyn, N. Y.

MID-STATES WELDER MFG. CO., Chicago, Ill., was recently formed to take over manufacture of the lines of welding equipment formerly produced by the Mid-States Equipment Corp., manufacturers of high-frequency arc stabilizers.

TEXAS ENGINEERING & MFG. CO., INC., Dallas, Texas, recently placed in full-scale operation four accessory shops within its plant. One of

Save Space and Weight with TRIAD "HS" Transformers

1939 Transformer
Dims: $3\frac{3}{8}$" x $3\frac{3}{8}$" x $3\frac{7}{8}$"
Weight: $2\frac{3}{4}$ lbs.

TRIAD "HS" Audio Input Transformer
Dims: $1\frac{7}{16}$" x $1\frac{3}{4}$" x $2\frac{1}{2}$"
Weight: 12 oz.

Both transformers shown above are high fidelity input transformers, frequency response from 20-20,000 cycles and 95db shielding.

Yet the Triad transformer is only **one-seventh as large by volume**, occupies **one-fourth the space** and is **one-fourth as heavy**. In the production of today's high fidelity equipment, where space is at a premium, that's important.

Triad "HS" (hermetically sealed) transformers, built to meet JAN specifications, are providing new standards of performance for quality electronic equipment — yet they cost little more than ordinary cased types.

Triad builds a complete line of transformers for original equipment, replacement, geophysical and amateur applications.

Write for Catalog TR-49

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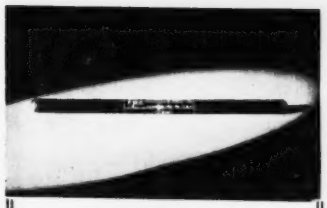
Los Angeles 64, Calif.



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- Used for extending range of V T voltmeters for television and other high voltage measurements
- Easily mounted or built into probe handles
- Sizes available up to 80 KV.
- Lengths from 1 inch to 13 inches
- Resistance to 10,000 megohms.
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Also manufacturers of wire wound precision, high voltage, high megohm and high frequency resistors.

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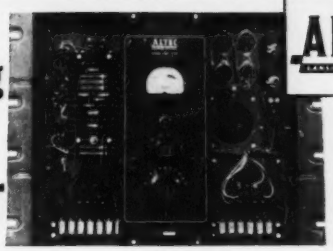
the Altec Lansing A-256A amplifier



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WILL MEET YOUR REQUIREMENTS FOR AUDIO POWER

Your need for high quality audio frequency power can be handled better, with greater dependability and with better quality by the Altec A-256A Beam Power Amplifier. Rated conservatively at 65 watts, the A-256A Amplifier will deliver 75 watts with less than 2% total harmonic distortion. At 65 watts the intermodulation is only 8%. Never before has there been a high quality amplifier which will deliver you as many watts per dollar as you receive from the A-256A Amplifier. Full power available within 1 db at 40 cycles and 15,000 cycles.

The A-256A Amplifier is assembled on a relay rack of recess pan construction, making it adaptable to either rack or cabinet mounting. Sound design and the use of conservatively rated quality components insure the user of long trouble-free life without deterioration in performance characteristics.

SPECIFICATIONS

GAIN: 50 DB, 500 ohm input.
FREQUENCY RANGE: 20-20,000 cycles within ½ DB.
NOISE LEVEL: —45 dbm (.001 watt reference).
OUTPUT IMPEDANCE: Taps for 8 & 16 ohm loads.
INPUT IMPEDANCE: 30, 250 & 500 ohms. 5,000 ohm bridging input.

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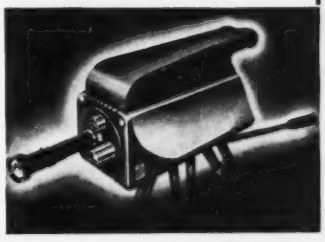

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The short time breakdown voltage of a well-made D.C. capacitor is not less than 5 to 6 times the actual working voltage at 20°—

$E = 5 \times e$ min.

E = Breakdown voltage
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INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety factor and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitor in industrial applications.

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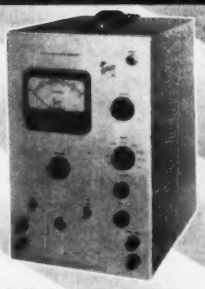
SQUARE WAVE GENERATOR

Continuously Variable, 25 CPS-1 MC
Rise Time, .02 Microseconds
Direct Reading Frequency Meter
Versatile Output Circuit

Square wave testing techniques come into wider use as the need for good transient response in wide band amplifiers becomes increasingly important. In order to test the high frequency response it is necessary to have a signal which has a rise and fall at least equal to and preferably faster than the risetime of the amplifier being tested. In addition to a sharp rise and fall, the test signal should be free of over-shoot and other spurious responses. For examination of the low frequency response a square wave signal having flat horizontal portions is needed.



TEKTRONIX Type 105
Square Wave Generator
Price $395.00 f.o.b.
Portland, Oregon

The TEKTRONIX **Type 105** *Square Wave Generator provides a suitable signal for both of the above tests. Its frequency range, extending continuously from 25 cycles to 1 mc., combined with its risetime of .02 microseconds, makes it possible to quickly and accurately test amplifiers, filters, etc., having pass bands from a few cycles to 20 mc.*

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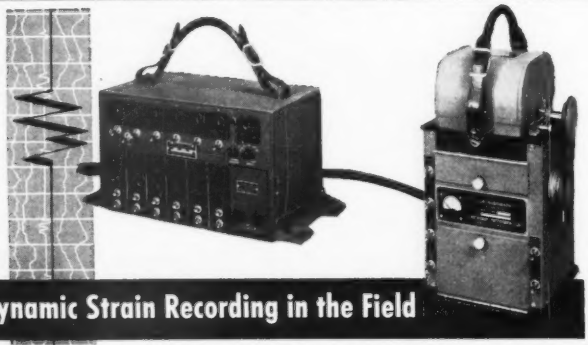

Dynamic Strain Recording in the Field

The TYPE MRC-12 6-ELEMENT SELF-POWERED STRAIN GAGE CONTROL UNIT, and the TYPE S15-A 6-ELEMENT SELF-POWERED RECORDING OSCILLOGRAFH together make up a complete dynamic strain measuring laboratory which you can carry with you for field use ANYWHERE where electrical power is not available.

With standard SR-4 resistance strain gages, a frequency response from static to 500 cycles per second can be obtained. Magnifications are adequate for all practical needs for static-dynamic strain recording on structural members and machine parts.

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Write for Technical Bulletin SP-177G and SP-193G

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PERSONNEL

HENDLEY BLACKMON, managing editor of *Electrical World* since 1947, was recently appointed assistant manager of engineering association activities for Westinghouse Electric Corp., East Pittsburgh, Pa.

H. Blackmon M. G. Staton

MAURICE G. STATON, formerly a communications systems engineer in the RCA Engineering Products Department, was recently appointed sales manager of microwave relay and channeling equipment in the same department.

WILLIAM W. FOLLIN, formerly electronic engineer in the Design Branch, Test Equipment Section of the Bureau of Ships, Navy Department, has joined Radio Frequency Laboratories, Inc., as field engineer for the Washington, D. C., area.

ALLEN S. DUNBAR, recently an electronic scientist with the Naval Research Laboratory, Washington, D. C., has been named research engineer at the new Aircraft Radio Systems Laboratory at Stanford Research Institute. He will have charge of the microwave antennas division.

J. PRESPER ECKERT, JR., chief engineer of the ENIAC digital electronic computing machine project, was recently awarded a Howard N. Potts Medal by the Franklin Institute, Philadelphia, Pa.

EDWARD DASKAM, JR., assistant radio engineer of General Telephone System, New York, N. Y., since 1946, has been appointed radio engineer of the System.

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Wire ● Rod for Contacts
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NEW BOOKS

Elements of Sound Recording

By John G. Frayne and Halley Wolfe. *John Wiley and Sons, Inc., New York, N. Y.*, 1949, 686 *pages*, $8.50.

This is a book dealing with a specialized field which is of interest to many persons. It incorporates much information which previously has been available only in the files of various professional magazines. The material is presented in well organized form, with the gaps that normally would exist between various source papers well filled in. The style of presentation is clear and very readable throughout the book.

The first twelve chapters, somewhat over two hundred pages, are devoted to a review of fundamental material on microphones, amplifiers, attenuators, equalizers and other subjects which are prerequisites to an understanding of the electrical and mechanical aspects of recording systems. While perhaps not essential to professional workers experienced in this field, it is a convenience to have this material available in one set of covers for reference, and it certainly is of considerable value to the student.

The main interest of the authors is indicated by the preponderance of information on sound-film recording, concerning which there are some twelve chapters. There are also two chapters on disk recording and one on magnetic recording. Even with such a disparity in the space devoted to the three main types of recording media, there is still a good deal of assembled fundamental information on disk and magnetic recording which it would be possible to locate alternatively only in a well-stocked technical library.

There are other chapters generally applicable to all recording systems, such as those dealing with mechanical drives and flutter. Various important aspects of playback and reproduction are treated to a considerable extent, although the book is primarily concerned with recording. The mathematical material throughout is brief and to the point, being included mainly to supplement the generally very capable physical treatments.

The undersigned reviewer recom-

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To get the most out of electronic equipment, your personnel must thoroughly understand its fundamentals, advantages, and limitations. To help you with this training problem, General Electric has prepared a complete, easy-to-take visual course in industrial electronics.

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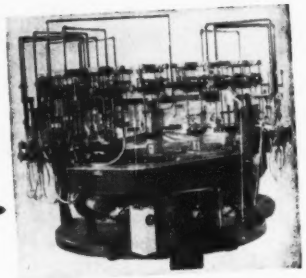
#1405 Cathode Ray Tube Sealing Machine

16 heads for sealing up to 12½ inch tubes; 12 heads for sealing up to 16 inch tubes. Adaptors for these sizes instantly interchangeable.



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RADIO INTERFERENCE AND FIELD INTENSITY METER

- MEASURES radiated and conducted signals, including pulse or random interference.
- RANGE—14 kc to 250 kc.
- SENSITIVITY — Field strength using rod antennas one microvolt-per-meter to 2 volts-per-meter. Field strength using shielded loop antennas 10 microvolts-per-meter to 100 volts-per-meter. As a two-terminal voltmeter, either balanced or unbalanced, one microvolt to one volt.
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- A.C. POWER SUPPLY REQUIREMENTS 105 to 125 volts or 210 to 250 volts A.C. Single phase source may be ANY FREQUENCY BETWEEN 50 CPS AND 1600 CPS. No shock hazard.
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Phone: Hudson 7313

mends this book as a very welcome addition to the literature of sound recording, with but one reservation. It is heavy, almost three pounds, and he respectfully directs the attention of all technical-book designers to the acceleration of gravity, which makes it a form of manual labor to read such a book anywhere except at a desk or table.

The opinions or assertions contained in this review are those of the reviewer, and are not to be construed as official or reflecting the views of the Department of the Navy.—EMERICK TOTH, *Naval Research Laboratory, Washington, D. C.*

Pulses and Transients in Communication Circuits

BY COLIN CHERRY. *Chapman & Hall, Ltd.*, 37 *Essex St., London, WC 2*, 1949, 317 *pages*, 32/S.

THIS volume presents an essentially mathematical subject in as nonmathematical terms as would appear possible. By holding to fundamental physical concepts and an engineering rather than a mathematical approach, a basis for solving fundamental transient problems of communication engineers is presented in lucid and understandable style. Knowledge of algebra, ordinary calculus, and some familiarity with communication engineering are required of the reader. This book should be especially helpful to engineers desiring to extend their knowledge of conventional alternating current theory to include the basic concepts of spectra and transient behavior in networks as treated by Fourier integral techniques.

The first chapter begins with a review of the solution of network differential equations. Basic ideas connecting spectra and transients are next introduced, followed by a review of fundamental network characteristics. The modifying effects of networks on spectra and waveforms are then brought out and the fundamental concepts of Fourier integral solutions to transient problems are illustrated. Approximations and simplifications necessary in engineering analyses are clearly pointed out in Chapter 5. A consideration of multistage

amplifiers and their effects on transient signals is followed by a very understandable treatment of asymmetric sideband distortion of either steady-state or transient signals. The last chapter is concerned with reflection and echo effects in lines and lumped networks. An adequate list of references in each chapter puts the reader in touch with basic source material for more extended study and adds materially to the value of the book.

In the reviewer's opinion this book would gain in value by the inclusion of more practical illustrative problems. Some mention of Laplace transform methods and their close relation to the Fourier integral approach would aid in bridging the gap for the reader "between conventional a-c theory and operational methods". However these limitations do not seriously detract from the practical value of this book. It can be well recommended for the reader desiring to learn about the subject from the engineering as opposed to the mathematical point of view.—J. GREGG STEPHENSON, *Airborne Instruments Laboratory, Mineola, N. Y.*

Maintenance Manual of Electronic Control

Edited BY ROBERT E. MILLER. *McGraw-Hill Book Co., Inc., New York,* 1949, 304 *pages,* $4.50.

BASED on a series of articles published in *Electrical Construction and Maintenance* on the installation and service of electronic equipment.

THE ARTICLES chosen to make up this book seem to have been tailor-written, and when combined furnish the beginner or the veteran in electronic control with an understandable and exceptionally practical picture of maintenance problems that are likely to appear in the field. Each section brings out the practical considerations of a different phase of electronic control in a way that approaches the thoroughness of the legendary old-timer's sharing of knowledge with an eager beginner.

Each chapter includes a systematic trouble-shooting chart for the type of equipment discussed. Particular emphasis is placed on the cathode-ray oscilloscope and its application to trouble-shooting and

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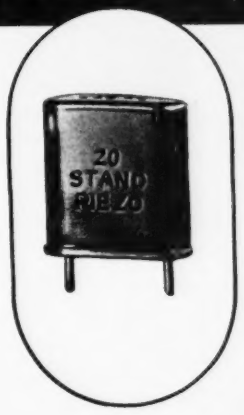

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other special applications. The illustrations, of which there are many, are planned so that actual installation photographs are distributed throughout the book, giving the reader a clear picture of the appearance of the equipment about which he is reading.

The book should be a valuable aid to any engineer, maintenance man or technician who is involved in any way with timing relays, time-delay relays, photoelectric relays, electronic motor control, welding control, furnace temperature control and mercury-arc rectifiers. Perhaps more emphasis could have been placed on such topics as electronic heating, metal detection and industrial process control.—J. F.

Elements of Electromagnetic Waves

BY LAWRENCE A. WARE, *Professor of Electrical Engineering, State University of Iowa. Pitman Publishing Corp., New York,* 1949, 203 *pages,* $3.50.

THIS compact text of electromagnetic theory is aimed at the undergraduate electrical engineering student and has been tested in the classroom at the University of Iowa. In a field of study stimulated by wartime microwave research Professor Ware's book assembles the basic classical theory in a logical and digestible presentation.

His aims are strictly limited and well-defined for the course as a whole, with each lesson introduced by a purposeful summary. Such fundamental concepts as gradient, divergence, curl, the Laplacian, the operator "del", and vector and scalar potentials are concisely presented. The theorems of Stokes and Gauss are derived and lead to Maxwell's four basic laws. From that point on, a treatment of bounded and unbounded plane waves develops into the theoretical aspects of simple modes in rectangular waveguides.

The concluding chapter introduces the subject of radiation, particularly with respect to the loop and dipole, and so serves as a preview of the more elaborate problems to be met in advanced work.

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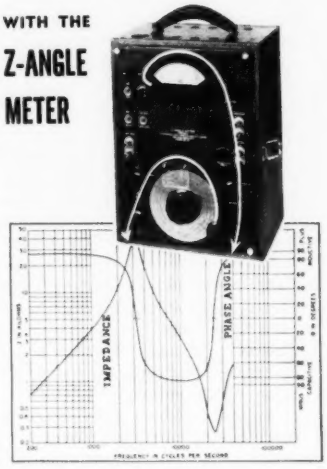

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justification, and emphasized thereafter throughout the text. Special mathematical tools are explained when needed. This is a solid little textbook that may well serve as a refresher for the practicing engineer who is somewhat weak in fundamental theory.—WILLIAM P. PEYSER, *Airborne Instruments Laboratory, Mineola, N. Y.*

• • •

Books Received for Review

INGENIERIA DEL RADAR. By Donald G. Fink. Editorial Nigar, Estados Unidos 932, Buenos Aires, Argentina. Translation of McGraw-Hill Book Co.'s book "Radar Engineering" into Spanish by Carlos E. Prélat.

KEY AND ANSWERS TO NEW RADIO-TELEGRAPH EXAMINATION QUESTIONS. Compiled and published by Alexander A. McKenzie, 245 Poplar Ave., Hackensack, N. J., 1949, 62 pages, $1.00. Supplements ninth edition of Nilson and Hornung's "Radio Operating Questions and Answers," giving well-illustrated answers to typical FCC questions in easy-to-understand language. Includes answers to all questions in Element 1, and answers to recently added questions in Elements 5 and 6.

ATOMIC ENERGY LEVELS. By Charlette E. Moore. Volume 1 of NBS Circular 467. Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C., 352 pages, $2.75. Compilation of all known data on energy levels of elements with atomic numbers 1 through 23.

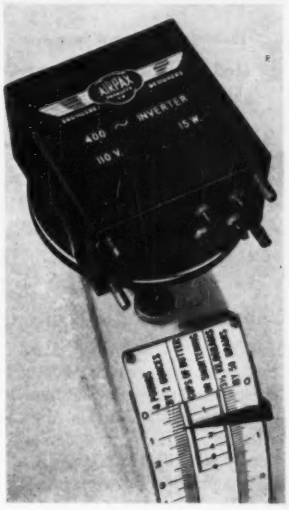
UNIFIED SCREW THREAD STANDARDS. Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C., 27 pages, paper cover, 30¢. Detailed illustrations, tables and numerical data on new unified American, British and Canadian standards providing for a 60-degree angle and a rounded root for screw threads, and standard numbers of threads per inch for various diameters of screws.

RCA TELEVISION PICT-O-GUIDE, Vol. I. By John R. Meagher. Radio Corporation of America, Tube Department, Harrison, N. J., 1949, 100 pages, loose-leaf. Available only from RCA tube distributors. Reproductions of test patterns obtained on receiver using RCA 630TS circuit when various faults or circuit changes are intentionally introduced, with informative details in captions and on backs of many of the cards.

COMMUNICATION CIRCUITS. By L. A. Ware and H. R. Reed. John Wiley & Sons, Inc., New York, 1949, Third Edition, 403 pages, $5.00. First-course text for communication engineering, revised to conform with advances made during World War II. Many new problems have been added, and the treatment of attenuation in waveguides is now based on Poynting's theorem.

ESTABLISHMENT AND MAINTENANCE OF THE ELECTRICAL UNITS. By F. B. Silsbee. NBS Circular 475. Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C., 38 pages, 25c. History of the international system, measuring methods used, references, and appendix of pertinent U. S. laws and resolutions.

TABLES OF SINES AND COSINES TO FIFTEEN DECIMAL PLACES AT HUNDREDTHS OF A DEGREE. Available from Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C., 95 pages, 40c. Columns of sines and cosines are arranged side by side, with second central differences alongside for interpolation to the full 15 places. Issued by National Bureau of Standards.



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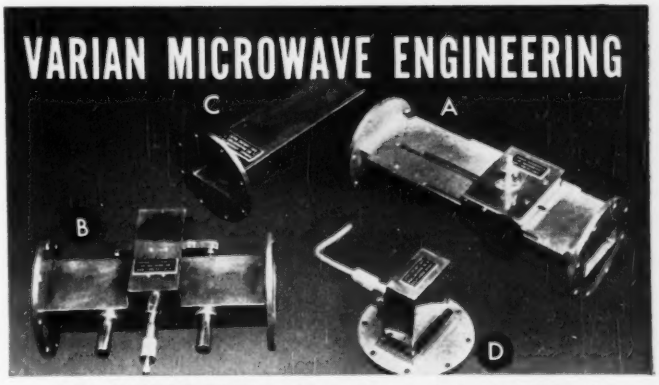

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Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which ELECTRONICS has published.

Wanted: Rock Detectors

DEAR SIRS:

CURTISS R. SCHAFER'S article in the September issue of ELECTRONICS, "Metal Detector for the Lumber Industry", will be of considerable interest in both the United States and Canada, where much lumber is cut.

In addition to hidden metal fragments in the logs, the Canadian lumber industry has another similar headache—imbedded rock particles. Logs floated down stream to the mill frequently pick up small stones, probably from striking or scraping the rocky stream bottom. Such rock particles are frequently invisible, not easily detected, and are quite destructive to the saw.

W. R. MEREDITH
Patent Attorney
Ottawa, Canada

Pennies Don't Always Make Cents

DEAR SIRS:

BEING ONE OF the unfortunate creatures who were raised with the metric system, I have tried hard to keep pace with the American system of weights and measurements, but I am afraid I will never make it.

In the September issue of ELECTRONICS, page 103, (Metal Detector for the Lumber Industry) you describe a piece of metal with the "size of a 16-penny nail." I tried in vain to find this unit of size in your own ELECTRONICS DICTIONARY or in any other tabulation of units.

First one should think that a 16-penny nail is one which costs 16 cents, but I was told that the 16 cents do not refer to one nail, but to 100 nails. Apparently the price of nails has been stretched like rub-

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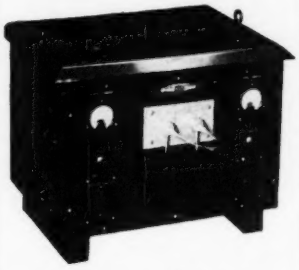

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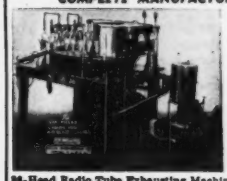

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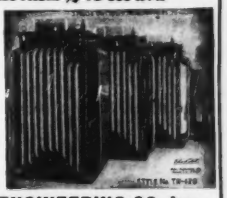

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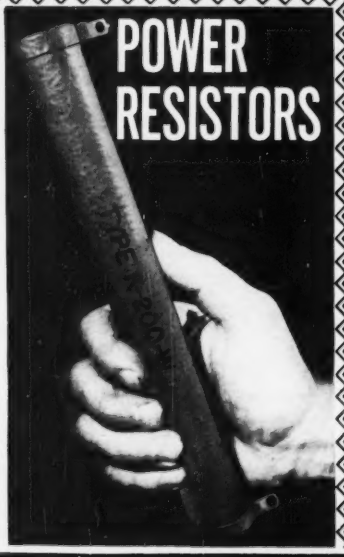

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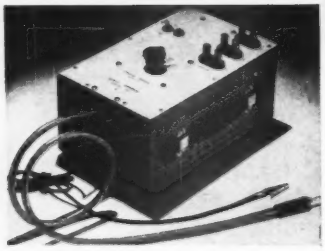

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ber since the Pilgrims came to Plymouth Rock, or, the other way around, the size of the nails for 16 cents has shrunk more than an unsanforized shirt of modern days.

To keep the holy unit alive, it has been agreed that the penny designation should not have anything to do with the price of the nail, but with the length of the nail and in this shape, in our electronic age, the x-penny nail was accepted by ELECTRONLIS as a unit to describe a size.

Would you be so kind as to tell me what length and diameter (or weight) your 16-penny nail has, to satisfy my urge to brush up on units and measurements?

GEORGE KEINATH
Larchmont, N. Y.

EDITOR'S NOTE: It seems to us that Dr. Keinath has hit the nail on the head in the above letter. We regret not having given the dimensions in CENTimeters rather than penny sizes. Research (a trip to a local hardware store and a few minutes with micrometer and a ruler) reveals that a 16-penny nail is one which has a diameter of 0.156 inch and a length of 3.437 inches.

Spark Plug Tester

DEAR SIRS:

I READ WITH INTEREST the article in the June, 1949, ELECTRONICS entitled, "Spark Plug Tester," by Craig Walsh and A. L. Livera. Similar circuits are described in a patent application filed by the writer some years back.

The principle criticism of these thyratron type circuits as interrupters for ignition coils lies in their inherent instability under line voltage fluctuations. It is questionable whether the use of such a circuit with an auto-transformer would "maintain its reliability regardless of variations in line voltage." An attempt was made to compensate for such variations in the present writer's circuits by using a transformer with isolated secondary, filter and ballast tubes. Even in this type of arrangement there were periods of missing in the sparking output of these coils during the time the ballast tubes were lagging in their abilities to catch up and keep pace with even the

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slower type of line fluctuations.

It appears from this article that what the authors have really suggested to circumvent this annoying characteristic of the circuit, is the comparison method rather than an objectively quantitative method based on preset standards. This is, of course, an old reliable method of testing components and gives results which approach the reliability of the standards used.

In another variation of this circuit, the writer employed selenium rectifiers in a voltage doubling circuit and eliminated the transformer. Unfortunately, in most shop testing applications, neither this method nor the auto-transformer are suitable, since by far the majority of automotive ignition coils have the secondary grounded to one side of the primary and there exists the possibility of placing the operator across one side of the line and ground.

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Perhaps the article did not indicate clearly enough that its consistent operation in spite of variations in line voltage, heating of the components, and aging of the tube, was due to the voltage control which operated by shifting the phase of the voltage applied to the grid of the tube. It may be pointed out that instantaneous changes in line voltage were not a serious problem because of their relative infrequency and because, in effect, the tester is recalibrated during each test by comparison with a fresh spark plug.

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(Continued on page 243)

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(Continued from page 243)

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PE 73CM	28	19	1009	.350	BC375
DM 21	14	3.3	235	.090	BC312
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			14.5	.5	
#5053	28	1.4	250	.060	APN-1
CW 21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
BD 77KM	14	40	1000	.350	BC191
PE 94	28	10	300	.260	SCR
			150	.010	522
			14.5.5		
DY12	27	32	400	.750	
			750	.350	

LARGE VARIETY AVAILABLE AT GREAT SAVINGS WRITE OR PHONE FOR QUANTITY AND PRICE OF TYPES REQUIRED

TUBES!

01-A	2SD7	804	
1B26	30 (Spec.)	815	
2C21	45 (Spec.)	836	
2C22	39-44	837	
2J21-A	35/51	843	
2J22	227A	860	
2J26	225	861	
2J27	268-A	874	
2J31	355-A	876	
2J32	417A	1005	
2J38	530	1619	
2J39	531	1624	
2J34	532	1629	
2J40	559	1961	
2J49	562	9002	
3J3	615	9004	
2K41	700 A,B,C, D	CEQ 72, EF 50	
2X2/879		F-127	
3BP1	703-A	FC 258A	
2C24	704-A	GL 559	
2C30	705-A	GL 562	
3D6	706 AY, BY,DY	FC 271	
3CP1		GL 562	
3D21-A	706 EY, FY,GY	GL 623	
3DP1		GL 692	
3EP1	†707-B	ML 100	
3FP7	714AY	QK 59	
3Q5	715-B	QK 60	
5BP1	720BY	QK 61	
5CP1	720CY	QK 62	
5FP7	721-A	VR 91	
5J30	723-A/B	VR 130	
6G	724B	VR 135	
6SC7	725-A	VR 137	
7C4	726-A	VU 120	
7E5	728 AY, BY,CY	VU 134	
7E6		WL 532	
10Y	752B DY, EY,FY, GY	WN 150	
12A6		WT 260	
12KSY		WRITE	
12SE7	730A	FOR	
12SR7	809	QUANT.	
15P	801-A	PRICE	

SHOCK MOUNTS

Lord	#1	10¢
Lord	#6	10¢
Lord	#5	10¢
Lord	#15	15¢
Lord	#12	15¢
Lord	#35	18¢
U. S.	#5150-C	55¢
Lord	#4	35¢
Lord	#1	14¢
Lord	#10	25¢
Lord	#8	20¢
Lord	#35	45¢
Lord	#20	39¢
Lord	#25	45¢
Henrite	#55	49¢
Lord	#15	35¢
Barry	#C2070	55¢
Barry	#C2060	55¢
Barry	#C2090H	55¢

Many Others In Stock

CERAMICONS

MMF.		
1	25	79
3	27	115
3.1	35	125
4	30	150
5	47	180
6	50	200
7	57	220
8.5	58	240
11	60	250
15	62	350
20	67	1000
24	70	

100 For $7.50

Button		Feed Thru
40	100	50
180	200	500
175	500	470
185		

100 For $9.50

T.V. Transformer, 7 or 9 scope, 3000v 5MA, 720vct 200MA, 6.4/8.7A, 6.4/.6A, 5V/3A 1.25/.3A..... **$4.95**

Price

- In 440/220/110v 60 cy 3kva out 115v 25kv ins. 12"x12"x7" $40.00
- In 220v 60 cy .05kva out 5vct 34kv Test $24.50
- In 115v/230v 50-60 cy out 21000v 160 MA $120.00
- In 220v 60 cy out 220v/360MA, 3x2.5v/5A, 2.5v/15A $6.75
- In 220v 60 cy out 10vct/13A, 7.5vct/2.5A $5.25
- In 240v 60 cy 7000vct/900MA, 470vct/750MA $135.00
- In 210/15/20/25/30/35/240v 60 cy out 11vct/35A 10vct/35A, 7.5vct/35A, 5vct/35A $37.50
- In 220/440 60 cy 1 ph out 123vct 2.85 amp Test 1780 $6.95
- In 230v 60 cy out 2.5v/6.5A $1.95

Rated Concerns Send P.O.

★★★SPECIALS★★★

ELECTROLYTIC CONDENSERS D.Y. TYPE TUBULAR, PRONG MOUNT, LUG TERM. FRESH 18c ea. 10 For $1.75 NEW

Mfd.	Volt	Mfd.	Volt
30	250	40+40	150
40	200	20+20	150
40	300	20	450
2 x 20	20	10	300
20+10	150	10	200
30+30	25	8	450
40+40	25	40	250
40	400	40	150
50	200	40-20	150
2 x 10	150	25/40	25/200
2 x 20	25	2 x 40	150
30+15	150		

29c each. 10 For $2.75

2 x 10	300		2x90-20	200/50	$.79
225	15		150-20-6	25/50	.49
20/20	350/25		120-60-20	150/25	.49
20/30	250		3x20	450	.69
2 x 30	150		2x20-20	450/25	.39
30+20	150		20-8-25	450/25	.49
30/20	350/25		40-20-20	450/25	.69
10-50/100	450/100/50		40+10+10	450	.98
15-15/20	350/25		40-40/25	475/400/50	.59
15-15/40	150/25		40/20/25	450/50	.69
25-25/10	25/350		40/40/16	450/400/350	.89
20-20/10	50/400		4x20	450	.98
2 x 20	150		2x30-15/20	400/25	.89
20/20	400/25		30-15-10/20	450/25	.89
10-20/20	350/25		3x10/10	450/25	.69
10-15/20	350/25		3x10/20	400/25	.69
15-15/20	250/25		80/40/150	400/50	.98
10-10/20	350/20		2x80-60	250	.65
3 x 10	150		150-50-25	150	.49
3 x 8	150		250-10/10	450/50	.49
12	525		2x20/20	400/25	.59
15	450		40-20/20	400/25	.59
10	450		40-40/25	400/25	.59
20	525		40-10/80	450/150	.69
80	150		40-40-10	450	.69
40+20+20	150		40-30-10	450	.89
40/20	150/25		3x15-30	300	.69
40/25	200/25		2x30/20x10	450	.98
40/30	150				
10/50/100	350/100/50				
10/10-10	25/150-150				
16	450				
20	350				
15	250				

DS TYPE CARDBOARD w/LONG PIGTAILS

Mfd.	Volt	Price
2x10	450	$.45
3x40	150	.65
20-20	150	.34
20-20	250	.45
30-30	150	.40
32-32	350	.49
30-30	150	.42
40-20	150	.42
40-32	250	.49
40-40	150	.42
32-16	450	.85
3x40-10	150	.98
80-40-30/100	150/25	.98
8-8/25	450/75	.98
30-20/20	450/25	.98
20-16/10	200/25	.59
50-30	350	.55
2x5020	150/25	.69
8	450	.35
16	450	.40
20	150	.18
20	450	.40

WRITE FOR OTHER VALUES IN STOCK

MINICAPS PIGTAIL

Mfd.	Volt	Price
30	450	$.49
30	300	.45
30	350	.45
40	450	.50
40	525	.65
16	350	.35
16	525	.45
16	450	.40
16	100	.24
20	25	.20
20	80	.25
20	450	.40
24	350	.30
8	400	.30
8	150	.15
10	150	.20
10	50	.15
4	50	.10
4	150	.14

POWER EQUIPMENT

- Fil. Trans. 110v 60 cy in., 5vct/30A out $8.95
- In 110v 60 cy out 6.3vct/20A, 6.3v/1.8A, 6.3v/600MA $4.95
- In 110v 60 cy out 2x5vct/6.75A, 5vct/13.5A, 2.5vct Test $6.95
- In 110v 60 cy out 10vct/13A, 10vct/6.5A, 6.3vct/2A $7.95
- In 115v 60 cy out 760vct/500MA, 880vct/40MA $10.95
- In 110v 60 cy out 690vct/400MA $6.95
- Tapped in. 107 to 127v out 160v to 200v/700MA 12 Taps $12.95
- In 110v 60 cy out 4v/16A, 2.5v/75A $4.75
- In 110v 60 cy out 17000v/144MA, w/choke 26" x 26" x 12" oil immersed $65.00
- In 115v 60 cy out 2x5v/5.5A 29kv ins. $24.50
- In 115v 60 cy out Tapped to give 2750/2470/2240/60 750 MA 7000v ins. $34.50

115V 60 Cy to 10800 V or 21000 V Dbl. PRICE.. $19.95

FILTER CHOKES

5 HY 40 MA, 3 for..	$ .99	20 HY 50 MA	$ .79
30 HY 25 MA	.79	12.5 HY 90 MA	1.39
25 HY .065A	1.00	6 HY 150 MA	.99
8.5 HY 125 MA	1.49	25 HY 75 MA	1.25
1.75 HY 100 MA	.59	.030 HY 2A	1.39
20 HY 24 MA	.98	5 HY 150 MA	1.45
15 HY 100 MA	1.39	Dual 7 HY 75 MA, 11 .2 HY 600 MA	1.95
HY 60 MA	1.39	Swing: 1.0-3.0 HY 225-.02A	.75 HY 225 MA 2.25
Dual: .22 HY 600 MA; 44 HY 400 MA	1.75		
Dual: 1.52 HY .167A	1.95	.100 HY 1.4A	1.95
Dual: 120 HY 17 MA	2.49	.333 HY 1.12A	2.29
Dual: 10 HY 200 MA	3.50	1 HY 1 Amp	3.95
3.5 HY 500 MA	4.95	20 HY 500 MA	7.95
10 HY 500 MA	12.95	10 HY 450 MA	12.95
Swing: 9-26 HY .225/.075 MA	4.95	30 HY 250 MA	4.95
6 HY 175 MA	1.50	2.5 HY 150 MA	1.25
.116 HY 150 MA	4.25	.01 HY 2.5A	1.45
.35 HY 350 MA	7.25	5 HY 200 MA	1.45

Write for list of many others.

COMMUNICATIONS EQUIPMENT COMPANY
CABLE ADDRESS: COMSUPO
PHONE DIGBY 9-4124
131 LIBERTY ST. DEPT. E
NEW YORK 7, N.Y.
C.E.C. MONEY BACK GUARANTEE, 13 MIN. ORDER.
F.O.B. N.Y.C. SEND MONEY ORDER OR CHECK, ONLY SHIPPING CHARGES SENT C.O.D.
RADAR TELEVISION ELECTRONICS
FM MICROWAVE RADIO SONAR

R. F. COMPONENTS—MICROWAVE—TEST EQUIPMENT

TEST EQUIPMENT

TS-117/GP 10 CM WAVEMETER TEST SET, Mfg. "Sperry" 2400-2400 MC. Micrometer Adj. Coaxial Cavity. Freq. Meas by absorption or transmission method. Mounts Crystal Current Meter & Calib. Chart.....$175.00

VSWR AMPLIFIER TS-12/AP. Unit 1 3 stages of Amplif. and Diode Rectifier w/direct VSWR, reading on meter. 115 volts 60 cyc. AC operation w/Inst. BK and CCT diag. New.....$285.00
SLOTTED LINE PROBE and Matched Termination incld'g Accessories TS-12/AP Unit 2 incl. UG81-U, CG92-U, CG91-U, CG89/U, UG79-U, CG87-U, MX150-U, CG98/U, CG99/U, UG80/U, plus Tools. New..$200.00
COMPLETE TS-12/AP UNITS 1 AND 2 $450.00

3 CM WAVE METER, Ordnance Type, Micrometer Head. Coverage 9000 to 95 MCS with calib. chart. Absorption type W/circ. Flange or XMSM type W/SQ flanges. New.....$75.00

MODEL TS-268/U

Test set designed to provide a means of rapid checking of crystal diodes 1N21, 1N21A, 1N21B, 1N23, 1N23A, 1N23B. Operates on 1½ volt dry cell battery. 3x6x7.

New.....$35.00

SL WAVEMETER Type Cw60ABM.....$125.00
10 CM ECHO BOX CABV 14ABA-1 of OBU-3, 2890 MC to 3170 MCS, direct reading micrometer head. Ring prediction scale plus 90 to minus 90. Type "N" input. Resonance indicator meter. New and Comp. w/access. Box and 10 CM Directional Coupler.....$350.00
3 CM RECEIVER, SO-3. Complete with WG Mixer Assy (723 A/B) Reg. Fil. Power Supply, 6 Stages IF (6AC7).....$99.50
10 cm. horn assembly consisting of two 5" dishes with dipole feeding single type "N" output. Includes UG28/U type "N" "T" junction and type "N" pickup probe. Mtg. cable. New.....$15.50
10 cm. cavity type wavemeters. 6 deep, 6½" in diameter. Coax output. Silver plated $64.50 ea.
10 CM. echo box part of SF radar w/115 volt DC tuning Motor sub sig 1118A.....$47.50
THERMISTOR BRIDGE: Power meter I-203-A 10cm. mfg. W.E. Complete with meter, interpelation chart, portable carrying case.....$72.50
W.E. I 138, Signal generator 2700 to 2900 Mc. range. Lighthouse tube osc. with attenuator & output meter. 115 VAC input reg. Pwr. supply. With circuit diagram.....$75.00
3 cm. stabilizer cavity, transmission type.....$20.00
3 CM. HORN AT-48/UP model 710. Type "N" input Hvy. silver plated.....$6.50
AT-58/UP 3 CM Horn with type N fitting.....$5.00
10 CM MICROMETER adjust. transmission cavity 2650-3000 mc w/calibration chart.....$75.00
TS-89/AP Voltage Divider: Ranges 100 ⅓ for 200 to 2000V 10; 1 for 200 to 2000v. Input Z 2000 ohm, output 2x 4 meg flat response 150-5 meg. cyc.....$42.50
10 CM WAVEMETER WE type B-435490 Transmission type. N fittings. Veeder read mtr. dial gold plated w/calib chart. P/O WE Freq mtr X66604A New.....$99.50

R. F. EQUIPMENT

LHTR. LIGHTHOUSE ASSEMBLY. Part of RT-30/APG-5 & APG 15. Receiver and Transmitter Lighthouse Cavities with assoc. Tr Cavity and Type N CPLG. To Recv. Uses 2C40, 2C43, 1B27. Tunable APN 2400-2700 MCMS. Silver plated.....$49.50
APS-2 10CM RF HEAD COMPLETE WITH HARD TUBE (7150) Pulser. 714 Magnetron 417A Mixer all ⅞" rigid coax. incl. recv. front end.....$210.00
Beacon lighthouse cavity 10 cm with miniature 28 volt DC FM meter. Mfg. Bernard Rice.....$47.50 ea.
T-128-/APN-19 10 cm. radar Beacon transmitter package, used, less tubes.....$59.50 ea.
SO-3 "X" band 3cm RF package, new complete, including receiver unit as illustrated on Page 337, Volume 23 RAD LAB Series.....$375.00 ea.
Pre-Amplifier cavities type "M" 7410590GL to use 446A Lighthouse tube. Completely tunable. Heavy silver plated construction.....$37.50 ea.
RT32/APS 6A RF HEAD, Compl. with 725A Magnetron magnet pulse xfmr. PHA ATR 723 A/B head rec. and beacon mount. pre amplifier. Used but exc. cond.....$97.50
AN/APS-15A "X" Band compl RF head and modulator, incl. 727 A magnetron and magnet, two 723A/B klystrons (local osc. & beacon) 1B24, TR, rev-ampl. duplexer, HV supply, blower, pulse xfmr. Peak Pwr Out: 45 KW apx. Input 115, 400 cy. Modulator pulse duration .2 microsec apx. 15 KV. PK. Pulse, with all tubes incl. 715B, 829B, BKR 73, two 72's. Complete pkg.....$210.00
S BAND AN/APS2. Complete RF head and modulator, including magnetron and magnet, 417A mixer, TR receiver duplexer, blower, etc., and complete pulser. With tubes, used, fair condition.....$75.00
10 CM. RF Package. Consists of: SO Xmtr-receiver using 2 -27 magnetron oscillator, 250 KW peak input. 707-B receiver-mixer.....$150.00

ASB-500 Megacycles Radar Receiver with two GL446 lighthouse cavities, new less tubes.....$37.50

10 CENTIMETER

WAVEGUIDE TO ⅞" RIGID COAX "DOOR-KNOB" ADAPTER. CHOKE FLANGE. SILVER PLATED. BROAD BAND. $37.50 EACH
WAVEGUIDE DIRECTIONAL COUPLER. 27 db. Navy type CABV-47AAN, with 4 in. slotted section.....$32.50
SQ. FLANGE to rd choke adapter 18 in. long OA 1⅛ in. x 3 in. guide, type "N" output sampling probe.....$27.50
Crystal Mixer with tunable output TR pick up loop. Type "N" connectors. Type 62AHH.....$14.50
Slotted line probe. Probe depth adjustable. Sperry connector, type CPR-14AAO.....$9.50
Coaxial slotted section, ⅞" rigid coax with carriage and probe.....$25.00
Right Angle Bend 6" radius E or H plain.$15.00
Right Angle Bend 3" radius E or H plain—Circular flanges.....$15.00
AN/APRSA 10 cm antenna equipment consisting of two 10 CM waveguide sections, each polarized, 45 degrees.....$75.00 per set
APN-7 McNally Cavity for 707B, with tuning stub.....$5.50 each
"S" BAND XTAL MOUNT. Gold plated w/2 type N connectors.....$12.50
PICKUP LOOP, Type "N" Output.....$2.75
TR BOX Pick-up Loop.....$1.25
POWER SPLITTER: 726 Klystron input dual "N" output.....$5.00
MAGNETRON TO WAVEGUIDE coupler with 721-A duplexer cavity, gold plated.....$27.50
10 CM WAVEGUIDE SWITCHING UNIT, switches 1 input to any of 3 outputs. Standard 1¾" x 3" guide with square flanges. Complete with 115 vac or dc arranged switching motor. Mfg. Raytheon. CRP-24AA8. New and complete $150.00
"S" BAND Mixer Assembly, with crystal mount, pick-up loop, tunable output.....$3.00
721-A TR CAVITY WITH TUBE. Complete with tuning plungers.....$12.50
10 CM McNally CAVITY Type SG.....$3.50
WAVEGUIDE SECTION Mc 445A Rt. Angle Bend 5⅜ ft. OA 8" Slotted Sect.....$21.00
10 CM OSC. PICKUP LOOP, with male Homedeli output.....$2.00
10 CM DIPOLE WITH REFLECTOR in lucite ball, with type "N" on spacy fittings.....$4.50
10 CM FEEDBACK ANTENNA in lucite ball, for use with parabola ⅞" Rigid Coax Input.....$8.00
PHASE SHIFTER. 10 CM WAVEGUIDE. WE TYPE ES-683816 E PLANE TO H PLANE. MATCHING SLUGS. MARK 8 RADAR. $95.00
721A TR cavities. Heavy silver plated.....$2.00 ea.
10 cm. horn and rotating joint assembly, gold plated.....$65.00 ea.

⅞" RIGID COAX.—⅜" I.C.

⅞" **rigid coaxial tuning stubs** with vernier sub adjustment. Gold Plated.....$17.50
⅞" **RIGID COAX ROTARY JOINT.** Pressurized Sperry 2-81613. Gold Plated.....$27.50
Dipole assembly. Part of SCR-584.....$25.00 ea.
Rotary joint. Part of SCR-584.....$35.00 ea.
RIGHT ANGLE BEND, with flexible coax output pickup loop.....$8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple.....$3.00
RIGID COAX to flex coax connector.....$3.50
STUB-SUPPORTED RIGID COAX, gold plated 27 lengths. Per length.....$5.00
RT. ANGLES for above.....$2.50
RT. ANGLE BEND 15" L. OA.....$3.50
FLEXIBLE SECTION, 15" L. Male to female.....$4.25
MAGNETRON COUPLINGS to ⅞" rigid coax, with TR pickup loop, gold plated.....$7.50
FLEX COAX SECT. Approx. 30 ft.....$16.50

⅞" RIGID ¼ "IC"

CG 54/U—4 foot flexible section ¼" IC pressurized.....$15.00
⅞" **RIGID COAX.** Bead Supported, per ft.....$1.20
SHORT RIGHT ANGLE BEND.....$2.50
Rotating joint, with deck mounting.....$15.00
RIGID COAX slotted section CU-60/AP.....$5.00

MISCELLANEOUS

Type "N" patching cord UG11-U female to UG9-U using RG5-U cable 12" long.....$2.25 ea.
AN-TPS-1B flanged nipple and insert assembly for rotary coupling.....$3.75 ea.
Pulse connector Navy type 49579.....$1.50 ea.
Transmission line pressure gauge, 2" 15 lbs.....$1.85 ea.
Pulse cable assembly Western Electric type D163262, 10 feet long.....$4.50 ea.
Holmdell Jack Western Electric HO-12962 1 D. B 2J 2N.....$3.75 ea.
Adapter type "N" RG8/U to RG17 U or 18 U cable.....$4.50 ea.
ADAPTER TYPE "N" TO RG-71/U CONNECTOR.....$5.50
F-29/SPR-2 HIGH PASS FILTER P/O AN/APR-5AX. TYPE "N" CONNECTORS.....$12.50
Magnetron coupling to ⅞ rigid coax.....$5.00 ea.
MAGNETRON COUPLING 1 ⅝" to 10 CM Waveguide.....$84.50

200 MC COAXIAL PLUMBING

Right Angle Bend.....$35.00
T Section.....$55.00
T Section with Adapter to ⅞" in rigid coax.....$65.00

1.25 CENTIMETER

"K" BAND MIXER SECTION.....$55.00
"K" BAND DIRECTIONAL COUPLER CU104/APS-34 20 DB.....$49.50 ea.
"K" BAND FEEDBACK TO PARABOLA HORN, with pressurized window.....$30.00
MITRED ELBOW cover to cover.....$4.00
TR-ATR SECTION choke to cover.....$4.00
FLEXIBLE SECTION 1" choke to choke.....$5.00
ADAPTER, rd. cover to sq. cover.....$5.00
MITRED ELBOW and 8 sections choke to cover.....$4.50
WAVE GUIDE ⅛ x ¼ per ft.....$1.00
K BAND CIRCULAR FLANGES.....50¢
3J31 "K" BAND MAGNETRON.....$55.00

3 CENTIMETER

(STD. 1" x ½" GUIDE UNLESS OTHERWISE SPECIFIED)

723 A/B Klystron mixer section with crystal mount, choke flange and Iris flange output.....$22.50
TR-ATR Section for above with 724 ATR Cavity.....$8.50
90 degree twist, 6 inches long.....$8.00
723 AB Mixer—Beacon Dual Oscillator Mount with crystal holder.....12.00
2 Way Waveguide directional coupler, type N fitting 1 ¼ x ⅝" guide 26DB.....$18.50
CG 98B/APG 15, 12" flexible section 1 ¼" x ⅝" OD.....$10.00
TR-ATR Section, APS 15, for 1B24, with 724 ATR Cavity with 1B24 and 724 tubes. Complete $21.00
Crystal Mount in Waveguide.....$17.50
SO3 Echo Box, XMSM type Cavity W/bellows.....$28.00
3cm. 180° bend with pressurizing nipple. $6.00 ea.
3 cm. 90° bend, 14" long 90° twist with pressurizing nipple.....$6.00 ea.
3 cm. "S" curve 18" long.....$5.50 ea.
3 cm. "S" curve 6" long.....$3.50 ea.
3 cm. right angle bends. "E" plane 18" long cover to cover.....$6.50 ea.
3 cm. Cutler feed dipole. 11" from parabola mount, to feed back.....$8.50 ea.
APS-31 mixer section for mounting two 2K25's Beacon, reference cavity 1B24 TR tube. New and complete with attenuating slugs.....$42.50 ea.
DUPLEXER SECTION for 1B24.....$10.00
CIRCULAR CHOKE FLANGES, solid brass......35
SQ. FLANGES, FLAT BRASS.....ea. .35
FLEX. WAVEGUIDE.....$4.00/Ft.
TRANSITION 1 x ⅝ to 1⅜ x ⅝, 14 in. L. $8.00

"X" BAND PREAMPLIFIER, consisting of 2-723 A/B local oscillator-beacon feeding waveguide and **TR/ATR** Duplex sect. incl. 30 Mc Pre Amp with tubes.....$57.50

Random Lengths waveguide, 6" to 18" Lg....$1.10/Ft.
WAVEGUIDE RUN, 1¼" x ⅝" guide, consisting of 4 ft. section with Rt. angle bend on one end 2" 45 deg. bend other end.....$8.00
12" SECTION 45 deg twist, 90 deg bend.....$6.00
11" STRAIGHT WAVEGUIDE section choke to cover. Special heavy Construction, silver plated.....$4.50
15 DEG. BEND 10" choke to cover.....$4.50

5 FT. SECTIONS choke to cover. Silver Plated.....$10.00

18" FLEXIBLE SECTION.....$17.50
"X" BAND WAVEGUIDE 1¼" x ⅝" OD. 1/16" wall Aluminum.....Per Foot $.75
WAVEGUIDE 1" x ½" I.D.....Per Foot $1.50
TR CAVITY for 724 A TR Tube.....$3.50
3" FLEX. SECT. sq. flange to Circ. Flange Adapt.....$7.50
724 TR TUBE (41 TR 1).....$2.50
SWR MEAS. SECTION, L with 2 type "N" output probes MTD full wave apart. Bell size guide. Silver plated.....$10.00
WAVEGUIDE SECTION, 12" long choke to cover 45 deg. twist & 2¼" radius, 90 deg. bend.....$4.50
SLUG TUNER/ATTENUATOR, W. E. guide, gold plated.....$6.50
TWIST 90 deg. 5" choke to cover w press nipple.....$6.50
WAVEGUIDE SECTIONS 2½ ft. long silver plated with choke flange.....$5.75
ROTARY JOINT choke to choke.....$17.50
ROTARY JOINT choke to choke with deck mounting.....$17.50
3 cm. mitred elbow "E" plane unplated $6.50 ea.

WAVEGUIDE

½" x ¼" ID.....$1.00 per foot
1" x ½" OD.....1.50 per foot
¾" x 1 ¼" OD.....1.65 per foot
⅜" x 1 ¼" OD Aluminum......75 per foot
1½" x ¾" OD.....1.00 per foot
2½" x 1" OD.....3.50 per foot
1" x ½" OD Flexible.....4.00 per foot
⅞" rigid coax ¼" IC.....1.20 per foot
(Available in 10FT to 15 ft. lengths or smaller.)
UG 65/U 10CM flanges.....$7.50 each
UG 53/U Cover.....4.00 each
UG 54/U Choke.....4.50 each

ALL MERCHANDISE GUARANTEED. MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND MONEY ORDER OR CHECK ONLY. SHIPPING CHARGES SENT C.O.D. RATED CONCERNS SEND P. O. MERCHANDISE SUBJECT TO PRIOR SALE

COMMUNICATIONS EQUIPMENT CO.

131 "E11" Liberty St., New York, N. Y. Att: P. J. Plishner Cable "Comsupo" Ph. Digby 9-4124

MAGNETRONS – RADAR – PULSE EQUIPMENT

MAGNETRONS

Tube	Freq. Range	Pk. Pwr. Out	Price
2J31	2820–2860 mc.	265 KW.	**$25.00**
2J31-A	9345-9405 mc.	50 KW.	**$25.00**
2J32	3267–3333 mc.	265 KW.	**$25.00**
2J36	2992–3019 mc.	275 KW.	**$25.00**
2J37	2935–2992 mc.	275 KW.	**$25.00**
2J32	2780–2820 mc.	285 KW.	**$25.00**
2J34	2700–2740	285 KW.	**$55.00**
2J37			**$45.00**
2J38 Pkg.	3249–3263 mc.	5 KW	**$35.00**
2J39 Pkg.	3267–3333 mc.	87 KW.	**$35.00**
2J40	9305–9325 mc	10 KW.	**$65.00**
2J49	9000–9160 mc	58 KW.	**$65.00**
2J61	3000–3100 mc.	35 KW	**$65.00**
2J62	2914–3010 mc.	35 KW.	**$65.00**
3J31	24.000 mc	53 KW.	**$55.00**
5J30			**$39.50**
714AY, A			**$20.00**
718DY	2720–2890	250	**$25.00**
720BY	2800 mc.	1000 KW.	**$50.00**
720CY	2860	1000 KW.	**$50.00**
725-A	9345-9405 mc.	50 KW.	**$25.00**
730-A	9345-9405 mc.	50 KW.	**$25.00**
728-AY, BY, CY, DY, EY, FY, GY		66	**$50.00**
700-A, B, C, D	680–710	50 KW. 66	**$53.00**
706-AY, BY, DY, EY, FY, GY		66	**$50.00**

Klystrons: 723A/B **$12.50**; 707B W/Cavity **$20.00**; 417A **$20.00** 2 K41 **$65.00**

MAGNETRON MAGNETS

Gauss	Pole Diam.	Spacing	Price
4850	3/4 in.	5/8 in.	**$12.50**
4200	21/32 in.	3/4 in.	**$17.50**
1380	1 5/8 in.	1 5/16 in.	**$12.50**
1840	1 5/8 in.	1 1/2 in.	**$14.50**

Electromagnets for magnetrons 700A $24.50 ea

GE Magnet type M7765115, GI distance between pole faces variable from 2 1/16" (1900 gauss) to 1 1/2" (2200 gauss). Pole dia. 1 5/8. P/o SCR 584. New **$34.50**

TUNABLE PKGD. "CW" MAGNETRONS

QK 61 2975–3200 mc. **QK** 62 3150–3375 mc.
QK 60 2800–3025 mc. **QK** 59 2675–2900 mc.
New Guaranteed ..... **Each $65.00**
QK 915 **Raytheon $150.00**

Fil. Trans. for above 115V/60 cy Pri; four 6.3V 4A Secs; 5000VPT **$27.50**
Magnetron Kit of four **QK**'s 2675-3375 mc. w/trans. special **$250.00**

TELEPHONE EQUIPMENT

Pike Pole. Telephone, MC123, for Wire Laying 2 sections, 4½ ft. ea. section w/M100 Lock. New. Unused **$5.90**
Telephone Handset Shell. For T810 Sound Power W.E. Light weight ..... **69¢**
Tape Bridge TG61B: McElroy used for standard 8½" White Paper, for Slight Reading and Typewriter transcription. SPECIAL PRICE **$5.50**

W.E. Teletype Switchboard #3. Complete Installation, 6 29 ft. bays. NEW. EXPORT PACKED. AVAILABLE FOR INSPECTION.

BC 686 LINE AMPLIFIER

With maghet ringer; 3-tube 2516 amplifier. For local point-to-point telephone operation, remote operation of Phone Xmtr, remote reception of receiver output, monitoring facility. Requires only 24 vdc for tube "B" plus supply for full operation.
New, less tubes, in wooden chest **$18.50**
per pair for 2 way pt-to-pt operation **$35.00**

SCR 584 SPARE PARTS AVAILABLE

400 CYCLE TRANSFORMERS

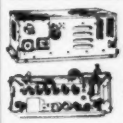
352-7273: Pri: 115V, 400 cy. Sec: 6.3V, 2.5 Amp; 6.3V, .06 Amp; 6.3V, .9 Amp; 3V, 6 Amp; 700 VCT, 2-5U4's. For **APS-15.** T201 ..... **$4.75**
352-7176: Pri: 115V, 400 cy. Sec: 6.3V, 20 Amp; 6.3V, .5 Amp; 6.3V, .5 Amp; 320V (2-0X5's) For **APS-15.** T202 ..... **$5.25**
352-7278: Pri: 115V, 400 cy. Sec: 2.5V, 1.75 Amp. 3500V (2x2). For **APS-15.** T203 (Anode #2). 5FDF **$5.85**
352-7070: Pri: 118V, 440 cy. Sec: 2.5V, 2.5 Amp; 2.5V, 2.5 Amp; (2000V, Ins.); 6.3V, 2.25 Amp. 1200V, Tpd at 1000 and 750V, P/o **AN/APS 15** **$4.95**
#7469105: Pri: 115V, 400 cy. Sec.: Tpd. to give 742.5V, 50 MA; 709V, .0477 A, 671V, .045 A **$2.95**
M-7474319: Pri: 115V, 400 cy. Sec: 6.3V, 2.7 Amp; 6.3V, 66 Amp; 6.3V, 21 Amp **$2.95**
32332: Pri: 115V, 400 2400 cy. Sec: 400 Vct, 35 MA; 6.4V, 2.5 Amp; 6.4V, 15 Amp **$2.25**
332-7138M: Pri: 115V, 400-2400 cy Sec: 640 V., 75 MA; 2.5V, 1.75 Amp **$3.85**
352-7179: Pri: 115V, 400-2400 cy. Sec: 6.3V, 12 Amp. Cy. 2500V, 100 MA; 5V, 2 Amp; **$3.50**
#9069: Pri: 115/80V, 400-2600 cy. Sec: 650 Vct, 50 MA; 6.3 Vct, 2 Amp; 5 Vct, 2 Amp **$2.45**
1.75 Amp. 3 Kv. Ins.; 5V, 3 Amp. 6.5V, 6.5 Amp. 6.5V, 1.2 Amp **$3.95**
KS 9007: Pri: 115V, 400-2400 cy. Sec: 734 Vct, 177 MA, 1710 Vct, 177 MA **$5.95**
D-160333: Pri: 115V, 400-2400 cy. Sec: 6.3V, 0.8 Amp. 7.7V, 0.365 Amp **$2.79**
G.E. #7471957: Pri: 100/110/120/130V, 400-2400 cy. Sec. 2.5V, 20 Amp. HV ins **$4.85**
D-163254: Pri: 115V, 400 cy. Sec: 6.3V, 12 Amp; 6.3V, 2A; 6.3V 1A. **P/O AN/APQ5** **$5.85**
KS-9685: Pri: 115V, 400-2400 cy. Sec: 6.4 Vct, 7.5 Amp; 6.4V, 3.8 Amp; 6.4V, 2.5 Amp **$4.35**

SUPER SONICS

QBS/Q JA Driven Oscillator units. Complete **$625.00**
QCU Magneto striction head RCA type CR 27x225—New **$75.00**
Stainless Steel streamlining housings for above **$18.50**
QBG Driver Amplifier. New **$200.00**
QCU Magneto striction head, coil plate assembly, new **$14.50**
QCQ—2/QCB Magneto striction head coil plate assembly **$14.50**

WILCOX CS390 CONTROL EQUIPMENT

FOR AIRPORT CONTROL GROUND STATION. Standard relay rack housing, monitor loud speaker, dual channel receiver amplifier Type 109 A control panel, microphone speech amplifier, etc., spare parts, new and complete ..... **$750.00 each**



3 CM RECEIVER

SO-3 Complete with W.G. Mixer Assy (723 A/B) Reg Fil. Power Supply. 6 Stages IF (6AC7) $99.50

30' U.S. ARMY SIGNAL CORPS RADIO MASTS

Complete set for the erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten foot sections for easy stowage and transportation. Supplies complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 300 lbs. Sig Corps #2A289-223-A. New ..... **$35.00 per set of 2**

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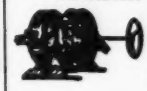

Input: 0.115 v. 50–60 cycle. Max., output: 115 v. 100 amp.
All units are new, guaranteed **$95**
2 KVA: 90-130v input 50–60 cycles, output 115v 2 kva type RH Amertran, ... **$29.95 each**

AM/APG2 Servo

PRECISION RESISTORS

1.01	125	1450	20000
3	128	1900	25000
5	150	2230	30000
5.05	200	4300	33000
	250	5000	35000
10.1	300	7000	40000
18	430	7500	50000
43.5	468	8500	55000
50	800	10000	57000
75	920	12000	75000
82		17000	Ship type
120	1100	17300	In stock
Above Ea ..	25¢	Ten For	**$2.25**
100000	150000	200000	
120000	170000	220000	500000
Above Ea.	35¢	Ten For ..	**$3.25**
1,000,000 ohms			**Each 75¢**

MARINE RADAR

SO-1 AND SO-8 RADAR SETS. Complete. In Used but Excellent Condition. 10 CM Surface Search using 5J26 or 5J27 Magnetron, 707 Mixer. PPI Indicator. Input 115VDC. Used on Merchant Ships throughout the world. FCC Approved. Guaranteed. $1250.00.

CRYSTAL DIODES

Type No.	Each	2 for	10 for
1N21	**$1.07**	**$1.79**	**$8.30**
1N22	**1.59**	**2.79**	**14.00**
1N23	**1.50**	**2.79**	**14.00**
1N26	**3.00**	**5.00**	**27.50**

THERMISTORS

D-167332 (tube)	**$.95**
D-170396 (bead)	**$.95**
D-167613 (button)	**$.95**
D-164600 for MTG in "X" band Guide	**$2.50**
D-167018 (tube)	**$.95**

VARISTORS

D-170225	**$1.25**
D-167476	**$.95**
D-168687	**$.95**
D-171812	**$.95**
171528	**$.95**
D-168549	**$.95**
D-162482	**$3.00**
D-163298	**$1.25**
D-99428	**$2.00**
D-161871A	**$2.85**
D-171121	**$.95**
3A(12-43)	**$1.50**
D-167020	**$3.00**

WRITE FOR C.E.C. MICRO-WAVE CATALOG NOW AVAILABLE

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 amp). Duty Ratio: 001 max. Pulse duration: .5, 1.0, 2.0 microsec. Input voltage: 115 v, 400 to 2400 cps. Uses 1-715-B, 4-829 B, 3-72's, 1-72. New **$110.00**

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.4 Micro Sec. Rep. rate 624 to 1348 Pps. Pk pwr. out 85 KW Energy 0.018 Joules **$49.00**

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KV (1200 KW pk); pulse rate 200 PPS, 1.5 microsec. pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes **$49.50**

APS-10 MODULATOR DECK. Complete, less tubes **$75.00**

BC 1203B IFF pulse modulator **$125.00**
BC 734A Pulse modulator **$395.00**
725A magnetron pulse transformers ..... $10.50 ea.

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec., 400 PPS, 50 ohms imp. **$42.50**
G.E. #6E3-5-2000-50PZT, 6KV, "E" circuit, 3 sections, .5 microsecond, 2000 PPS, 50 ohms impedance **$6.50**
G.E. #JE (3-84 310; 8-2 24-465) 50P4T; 3KV, "E" CKT Dual Unit: Unit 1, 3 Sections, .84 Microsec. 810 PPS, 50 ohms imp.; Unit 2, 8 Sections, 2.24 Microsec. 405 PPS, 50 ohms imp. **$6.50**
7.5E3-1-200-67P, 7.5 KV, "E" Circuit, 1 microsec. 200 PPS, 67 ohms impedance, 3 sections **$7.50**
7.5E4-16-60-67P, 7.5 KV, "E" Circuit, 4 sections, .16 microsec. 60 PPS, 67 ohms impedance. **$15.00**
7.5E3-3-200-6PT 7.5 KV, "E" Circuit, 3 microsec. 200 PPS, 67 ohms imp., 3 sections **$12.50**

DELAY LINES

D-168184: .5 microsec. up to 2000 PPS, 1800 ohm term **$4.00**
D-170499: .25/.50/.75/, microsec, 8 KV, 50 ohms imp **$16.50**
D-165997: 1¼ microsec **$7.50**

PULSE TRANSFORMERS

G.E.K.-2745 ..... **$39.50**
G.E.K.-2744-A, 115 KV high Voltage, 3.2 KV Low Voltage @ 200 KW oper. (270 KW max.); 1 micro sec. or ¾ microsec. @ 600 PPS **$39.50**
W.E. #D166173 Hi Volt input transformer, W.E. impedance ratio 50 ohms to 900 ohms. Freq. range: 10 kc to 2 mc, 2 sections parallel connected, potted in oil **$36.00**
W.E. K8 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380–520 c.p.s. Permalloy core. **$6.00**
G.E. #K2731 Repetition Rate: 635 PPS, Pri. Imp: 50 Ohms, Sec. Imp: 450 Ohms. Pulse Width: 1 Microsec. Pri. Input: 9.5 KV PK., Sec. Output: 28 KV PK. Peak Output: 800 KW. Rifflet 2.75 Amp **$64.50**
W.E. #D169271 Hi Volt input pulse Transformer **$27.50**
G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary deliveries 14KV. Peak Power out 100KW G.E. **$4.50**
G.E. #2748A Pulse Input, line to magnetron **$36.00**
#9280 Utah Pulse or Blocking Oscillator XFMR Freq. limits 750-810 cy. 3 windings turns ratio 1:1:3 Dimensions 1 13/16 x 1 3/8" 19/32 ..... **$1.50**
Raytheon U X 8093 3x:2 Turns T.V. 1000 RMS **$4.95**
G.E. 9318 Pulse Xfrmr 1:1:1 ..... **$1.50**
UX 1350 ..... **$8.95**
Pulse 132-AWP-1421435 ..... **$6.00**
Pulse 134-BW-2F-1440893 ..... **$2.25**

PRECISION CAPACITORS

D-163707: 0.4 mfd @ 1500 vdc, —50 to plus 85 deg C **$4.50**
D-163035: 0.1 mfd @ 600 vdc, 0 to plus 65 deg. C **$2.00**
D-170908: 0.152 mfd, 300v, 400 cy, —50 to plus 85 deg C **$2.50**
D-14960: 2.04 mfd @ 200 vdc, 0 to plus 55 deg C **$2.50**
D-168344: 2.16 mfd @ 200 vdc, 0 to plus 55 deg C **$3.00**
D-161555: .5 mfd @ 400 vdc, —50 to plus 85 deg C **$3.00**
D-166802: 16 mfd @ 400 vdc, temp comp 50 to 85 deg C **$12.50**
D-161270: 1 mfd @ 200 vdc, temp comp —40 to plus 65 deg C **$12.50**

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Full Line of UG Connectors in Stock
Immediate Delivery

AMPHENOL "AN" CONNECTORS

Large Variety Available
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SA SC SD SE SF SG SL SN SO1 SO3 SO8 SO9 SO13 SQ SU TAJ TRK TRL TRM APG5 APR APS2 APS3 APS4 APS6 APS10 APS15 ABA QBF QBG QCQ WEA RAK CPN3 CPN6 DAB RC145 RC148 YD ZA

FULLY GUARANTEED

BRAND NEW SURPLUS OFFERED BY A LEADING

A.C. MOTORS

5071930, Delco, 115 V., 60 Cycle, 7000 r.p.m. **Price $4.50 each net**

36938-2, Haydon Timing Motor, 110 V., 60 cycle, 2.2 w.; 4/5 r.p.m. **Price $3.00 ea. net.**

Haydon Timing Motor—110 V., 60 cycle, 3.2 w., 4 r.p.m., with brake. **Price $4.00 each net.**

45629R Haydon Timing Motor, 110 V., 60 cycle, 2.2w., 1/240 r.p.m. **Price $3.00 each net.**

1600 Haydon Timing Motor 110 V. 60 cycle 2.3 W. 1 r.p.m. **Price $2.70 each net.**

36938-3, Haydon Timing Motor, 110-V., 60 cycle, 2.2 w., 1 1/5 r.p.m. **Price $2.70 each net.**

36228 Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1/60 r.p.m. **Price $2.70 each net.**

Eastern Air Devices Type J33 Synchronous Motor 115 V., 400 cycle, 3 phase, 8,000 r.p.m. **Price $8.50 each net.**

Telechron Synchronous Motor, Type B3, 115 V., 60 cycle, 2 r.p.m., 4 w. **Price $5.00 each net.**

SERVO MOTORS

CK 1, Pioneer, 2 phase, 400 cycle. **Price $10.00 each net.**

CK2, Pioneer, 2 phase, 400 cycle. **Price $4.00 each net.**

10047-2-A Pioneer 2 phase, 400 cycle, with 40:1 reduction gear. **Price $7.25 each net.**

FPE-25-11, Diehl, Low-Inertia, 75 to 115 V., 60 cycle, 2 phase. **Price $16.00 each net.**

FPE-49-7 Diehl, Low-Inertia, 115 V., 60 cycle, 2 phase, 3.0 amps., 10 w., output. **Price $34.50 each net.**

FP-25-2, Diehl, Low-Inertia, 20 V., 60 cycle, 2 phase. **Price $9.00 each net.**

FP-25-3, Diehl, Low-Inertia, 20 V., 60 cycle, 2 phase. **Price $9.00 each net.**

CK2, Pioneer, 2 phase, 400 cycle, with 40:1 reduction gear. **Price $6.25 each net.**

MINNEAPOLIS-HONEYWELL TYPE B Part No. G303AY, 115 V., 400 cycle, 2 phase, built-in gear reduction, 50 in. lbs. torque. **Price $7.50 each net.**

REMOTE INDICATING MAGNESYN COMPASS SET

Pioneer Type AN5730-2 Indicator and AN5730-3 Transmitter 26V., 400 cycle. **Price $40.00 per set new sealed boxes.**

Kollsman Remote Indicating Compass Set Transmitter part No. 679-01, indicator part No. 680k-03, 26 V., 400 cycle **Price $12.50 each net.**

GYROS

Schwein Free & Rate Gyro type 45600. Consists of two 28 V. D.C. constant speed gyros. Size 8" x 4.25" x 4.25". **Price $10.00 ea. net.**

Schwein Free & Rate Gyro, type 46800. Same as above except later design. **Price $11.00 each net.**

Sperry A5 Directional Gyro, Part No. 656029, 115 volts, 400 cycle, 3 phase. **Price $17.50 each net.**

Sperry A5 Vertical Gyro, Part No. 644841, 115 V., 400 cycle, 3 phase. **Price $20.00 each net.**

Sperry A5 Amplier Rack Park No. 644890. Contains Weston Frequency Meter. 350 to 450 cycle and 400 cycle, 0 to 130 voltmeter. **Price $10.00 each net.**

Sperry A5 Control Unit Part No. 644836. **Price $7.50 each net.**

Sperry A5 Azimuth Follow-Up Amplifier Part No. 656030. With tube. **Price $5.50 each net.**

Pioneer Type 12800-1-D Gyro Servo Unit. 115 V., 400 cycle, 3 phase. **Price $8.00 each net.**

Norden Type M7 Vertical Gyro. 26 V., D.C. **Price $19.00 each net.**

Norden Type M7 Servo Motor. 26 V., D.C. **Price $20.00 each net.**

Allen Calculator, Type C1 Bank and Turn Indicator, Part No. 21500, 28 V. D.C. Contains 28 V. D.C. constant speed gyro. **Price $10.00 each net.**

D.C. MOTORS

Jaeger Watch Co. Type 44-K-2 Contactor Motor, Operates on 3 to 4.5 volts D.C. Makes one contact per second. **Price $2.00 each net.**

General Electric Type 5BA10AJ52C, 27 V. D. C., 0.65 amps., 14 oz. in. torque, 145 r.p.m. Shunt Wound, 4 lead reversible. **Price $4.70 each net.**

General Electric Type 5BA10AJ37C, 27 V. D. C., .5 amps., 8 oz., in. torque, 250 r.p.m. Shunt Wound, 4 leads reversible. **Price $6.50 each net.**

D.C. MOTORS

5069625, Delco Constant Speed, 27 V., 120 r.p.m. Built-in reduction gears and governor. **Price $3.90 each net.**

A-7155, Delco Constant Speed Shunt Motor, 27 V., 2.4 amps., 3600 r.p.m., 1/30 h.p. Built-in governor. **Price $6.25 each net.**

C-28P-1A, John Oster Shunt Motor, 27 V., 0.7 amps., 7000 r.p.m., 1/100 h.p. **Price $3.75 each net.**

D.C. ALNICO FIELD MOTORS

5069456, Delco, 27.5 V., 10,000 r.p.m. **Price $4.70 each net.**

5069600, Delco, 27 V., 250 r.p.m. **Price $5.00 each net.**

5069466, Delco, 27 V., 10,000 r.p.m. **Price $3.50 each net.**

5069370, Delco, 27 V., 10,000 r.p.m. **Price $4.70 each net.**

5069230, Delco, 27 V., 145 r.p.m. **Price $5.00 each net.**

S. S. FD6-16, Diehl, 27 V., 10,000 r.p.m. **Price $3.75 each net.**

S. S. FD6-18, Diehl, 27 V., 10,000 r.p.m. **Price $3.75 each net.**

S. S. FD6-21, Diehl, 27 V., 10,000 r.p.m. **Price $3.75**

Sampsel Time Control Inc. Alnico Field Motor, 27 V. D.C. Overall length 3 5/16" by 1⅜". Shaft ⅝" long by 3/16", 10,000 r.p.m. **Price $4.50 each net.**

GENERAL ELECTRIC D.C. SELSYNS

8TJ9-PDN Transmitter, 24 V. **Price $3.75 each net.**

8DJ11-PCY Indicator, 24 V. Dial marked —10° to +65°. **Price $4.50 each net.**

8DJ11-PCY Indicator, 24 V. Dial Marked 0 to 360°. **Price $7.50 each net.**

AMPLIFIER

Pioneer Gyro Flux Gate Amplifier, Type 12076-1-A. Price $17.50 ea. net, with tubes.

COMPLETE LINE OF AIRCRAFT THERMOCOUPLES

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IMMEDIATE DELIVERY

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Wincharger Corp. Dynamotor Unit. PE-101-C. input 13, V.D.C. or 26 V.D.C. D.C. AT. 12.6 or 6.3 amps. Output 400 V.D.C. AT. .135 amps., 800 V.D.C. AT. .02 amps., 9 V.A.C. 80 cycle at 1.12 amps. **Price $10.00 each net.**

153F, Holtzer Cabot. Input, 24 V.D.C. Output 115 V., 400 cycle, 3 phase, 750 V.A. and 26 V., 400 cycle, 1 phase, 250 V.A. Voltage and frequency regulated also built in radio filter. **Price $115.00 each net.**

149H, Holtzer Cabot. Input 28 V. at 44 amps. Output 26 V. at 250 V.A., 400 cycle and 115 V. at 500 V.A. 400 cycle. **Price $39.00 each net.**

149F, Holtzer Cabot. Input 28 V. at 36 amps. Output 26 V. at 250 V.A., 400 cycle and 115 V. at 500 V.A. 400 cycle. **Price $35.00 each net.**

12117, Pioneer. Input 12 V.D.C. Output 26 V., 400 cycle, 6 V.A. **Price $22.50 each net.**

12117-2 Pioneer. Input 24 V.D.C. Output 26 V. 400 cycle, 6 V.A. **Price $20.00 each net.**

5D21NJ3A General Electric. Input 24 V.D.C. Output 115 V., 400 cycle at 485 V.A. **Price $12.00 each net.**

PE218, Ballentine. Input 28 V.D.C. at 90 amps. Output 115 V., 400 cycle at 1.5 K.V.A. **Price $45.00 each net.**

WESTON FREQUENCY METER

Model 637, 350-450 cycle, 115 V. **Price $10.00 each net.**

WESTON VOLTMETER

Model 833, 0 to 130 V. 400 cycle. **Price $4.00 each net.**

VIBRATOR

Rauland Corp. vibrator non-synchros type Stock No. 3H6694-11; 6, 12 or 24 V.D.C., input frequency 200 cycle. **$3.25 each net.**

PIONEER AUTOSYNS

AY1, 26 V., 400 cycle. **Price $5.50 each net.**

AY14D, 26 V., 400 cycle, new with calibration curve. **Price $15.00 each net.**

AY20, 26 V., 400 cycle. **Price $7.50 each net.**

AY31, 26 V., 400 cycle. Shaft extends from both ends. **Price $10.00 ea. net.**

AY38, 26 V., 400 cycle. Shaft extends from both ends. **Price $10.00 each net.**

PIONEER PRECISION AUTOSYNS

AY101D, new with calibration curve.

PRICE—WRITE OR CALL FOR SPECIAL QUANTITY PRICES

AY131D, new with calibration curve. **Price $35.00 each net.**

AY130D, new. **Price $35.00 each net.**

PIONEER AUTOSYN POSITION INDICATORS

Type 5907-17, Dial graduated 0 to 360°, 26 V., 400 cycle. **Price $15.50 each net.**

Type 6007-39, Dual, Dial graduated 0 to 360°, 26 V., 400 cycle. **Price $30.00 each net.**

PIONEER TORQUE UNIT

Type 12602-1-A. Price $30.00 each net.

Type 12604-3-A. Price $30.00 each net.

Type 12606-1-A. Price $40.00 each net.

Type 12627-1-A. Price $80.00 each net.

MAGNETIC AMPLIFIER ASSEMBLY

Pioneer Magnetic Amplifier Assembly Saturable Reactor type output transformer. Designed to supply one phase of 400 cycle servo motor. **Price $8.50 each net.**

PIONEER TORQUE UNIT AMPLIFIER

Type 12073-1-A, 5 tube amplifier, Magnesyn input, 115 V., 400 cycle. **Price $17.50 each net with tubes.**

Type 12077-1-A, single tube Amplifier, autosyn input, 115 V., 400 cycle. **Price $49.50 each net, with tube.**

BLOWER ASSEMBLY MX-215/APG

John Oster, 28 V.D.C., 7000 r.p.m. 1/100 h.p. **Price $2.90 each net.**

Westinghouse Type FL Blower, 115 V., 400 cycle, 67000 r.p.m., Airflow 17 C.F.M. **Price $3.70 each net.**

RATE GENERATORS

PM2, Electric Indicator Co., .0175 V. per r.p.m. **Price $8.25 each net.**

F16, Electric Indicator Co., two-phase, 22 V. per phase at 1800 r.p.m. **Price $12.00 each net.**

J36A, Eastern Air Devices, .02 V. per r.p.m. **Price $9.00 each net.**

B-68, Electric Indicator Co., Rotation Indicator, 110 V., 60 cycle, 1 phase. **Price $14.00 each net.**

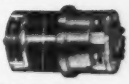
Weston Tachometer Generator (aircraft type) model 752-J4 single phase. A.C. output. **Price $17.50 each net.**

SINE-COSINE GENERATORS (Resolvers)

FPE 43-1, Diehl, 115 V., 400 cycle. **Price $20.00 each net.**

FJE-43-9, Diehl, 115 V., 400 cycle. **Price $20.00 each net.**

SYNCHROS



1F Special Repeater, 115 V., 400 cycle. Will operate on 60 cycle at reduced voltage. **Price $15.00 each net.**

7G Generator, 115 V., 60 cycle. **Price $30.00 each net.**

6DG Differential Generator, 90-90 V., 60 cycle. **Price $15.00 each net.**

2J1M1 Control Transformer 105/63 V., 60 cycle. **Price $20.00 each net.**

2J1G1 Control Transformer, 57.5/57.5 V., 400 cycle. **Price $1.90 each net.**

2J1H1 Selsyn Differential Generator, 57.5/57.5 V., 400 cycle. **Price $3.25 each net.**

W. E. KS-5950-L2, Size 5 Generator, 115 V., 400 cycle. **Price $3.50 each net.**

5G Special, Generator 115/90 V., 400 cycle. **Price $15.50 each net.**

5SF Repeater, 115/90 V., 400 cycle. **Price $19.00 each net.**

2J1F1 Selsyn Generator, 115 V., 400 cycle. **Price $3.50 each net.**

5SDG Differential Generator 90/90 V., 400 cycle. **Price $15.30 each net.**

ALL PRICES, F.O.B. GREAT NECK, N. Y.

INSTRUMENT ASSOCIATES

37 EAST BAYVIEW AVE., GREAT NECK, N. Y.
Telephone IMperial 7-1147

Write for complete listings

Western Union address: WUX Great Neck, N. Y.

Tremendous Savings at NIAGARA On All RADIO-TV Equipment!

TINIEST V.O.M. *in the World!*

NIAGARA **exclusively** presents the "Universal Baby Tester" measuring 3-7/8" x 2-1/8" x 1-5/16" ! ! ! Contains a sensitive 0-240 microammeter with the following ranges.

- 0-15V AC or DC
- 0-150V AC or DC
- 0-750V AC or DC
- 0-150 DC MA
- 0-100,000 ohms

Ohms adjust and DC-AC ohm switch. Includes 1 pair test leads. Will fit into your watch pocket. Fully guaranteed.

Cat. No. N-258 Special **$8.95**

TRANSFORMERS

POWER TRANSFORMERS ALL 117V. 60 CYCLE PRI.

T-47177	40VDC @ 250 ma. 5V @ 3A. 1600 V. ins. herm. sealed	$2.49
SP-105	725-0-725V. @ 60. ma., 5V @ 3A, 6.3V. @ 1.2A	2.95
511-T2	350V CT @ 150 ma. 6.3V @ 6A herm. sealed	2.10
475-T301	245-0-245 @ 70 ma., 6.3V @ 6.2A 1600V. ins. herm. sealed	2.75
466-T1R	110-0-110 @ 225 ma. 5V. @ 3A herm. sealed	3.25
PC-110	600V.C.T. @ 125 ma. 6.3V @ 3.8A, 5V @ 3A. 1600V. ins. herm. sealed	2.85

PLATE TRANSFORMERS

T-47168	540-0-540V @ 650 ma. Herm. sealed	9.95
475-T302	2350-0-2350V. @ 300 ma.	23.50
69125	2100V.C.T. @ 500 ma.	17.95

FILAMENT TRANSFORMERS

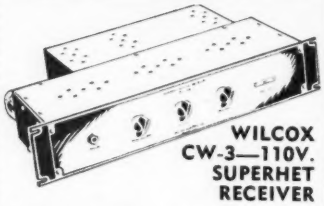
T-47164	6.4V @ 8A. 1600V. ins. herm. sealed	2.49
T-47167	5V. @ 9A. 3500V. ins. herm. sealed	2.75
SP-100	24V. @ 10A.	4.95
D161917	6.3V @ 3A., 2.5V @ 2A., herm. sealed	1.95
510-T4	6.4V @ 10A., 6.3V. @ 5A., 1200V. ins. herm. sealed	2.95
475-T201	5V. C.T. @ 15A., 1600V. ins. herm. sealed	2.75
510-T2	Bridge transformer 2.5V. @ 5A., 2.5V. @ 5A., 2.5V. @ 10A. herm. sealed	3.95

CHOKES - REACTORS

	Cap.	Current	Res.	Insul.	
L-143	1.72	4A.		10,000V	$6.95
L-554	20	125ma.	300		* 4.95
475-CH301	3.8	75 ma.	160	1600V.	* 4.15
475-CH302	10	300ma.	100	7500V.	* 5.25
14010	15	200ms.	150	2000V.	* 5.25
15406	12	225ma.	200		* 5.25
510-X2	15	200ma.	145		5.25
S-16886	2.5-24	50-400ma	53	10,000V.	8.95
S-16885	.875	400ma.	45	10,000V.	8.95
RC-72	15	125ma.	250	1,600V.	* 4.15
T-46256	12	275ma.		10,000V.	* 5.25
L-218	45	90			2.75
T-46256A	12	210ma.			5.25

* Herm. Sealed.

SUPER SURPLUS SPECIALS



WILCOX CW-3—110V. SUPERHET RECEIVER

The CW-3 Superhet receiver is a 7 tube fixed-tuned aircraft frequency unit. Circuit comprises RF mixer-oscillator, IF 2nd Detector, BFO, Audio Output, BFO Limiter and 110 V Power Supply stages. Brand new with one set coils, 5.6-10 mcs. Less crystal. Contains 2-6K7, 6K8, 2-6C8G, 80 and 6SN7 tubes. Size: 3½" x 19" x 11½". Grey wrinkle finish. Elaborate instruction book included. Shpg. wt. 50 lbs. In original overseas crates. Brand new with 2 sets tubes, 1 set coils, and instruction book.

Cat. No. N-252 Your Cost **$75.00**

304TL FILAMENT TRANSFORMER

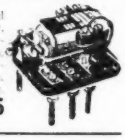
Husky open frame. 5V @ 25 amp filament transformers. Tubes such as 304TL, 304TH. Very desirable, very few on hand.

Cat. No. N-274 Special **$5.95**

7.5 Volt @ 20 amp. Same construction as above, for 450TH.

Cat. No. N-275 ..... **$5.95**

WHEELOCK SPDT RELAY



A fine, sturdy, well constructed 110 V. 60 cy. AC SPDT relay, built to rigid Government Standards. Contacts rated at 5 Amps. Excellent as plate or antenna relay. Extra long mounting screws. Brand new in original packing.

Cat. No. N-181 Your Cost **$1.45**

SPST 6 V.D.C. RELAY

Completely encased in compact round can 6 V.D.C. field, SPST contacts will take up to 50 amps.

CAT. NO. N-120 YOUR COST ..... **$ .98**

OVERLOAD RELAY

Westinghouse overload relay. Adjustable from 250 ma. to 1 amp. D.C. Manual reset, heavy construction, coil and contacts fully enclosed in ¼" glass shield. WORTH PLENTY.

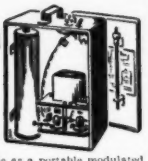
CAT. NO. N-122 YOUR COST **$12.95**

12 V.D.C. KEYING RELAY

DPDT high speed keying relay. 300 ohm coil, in grey vacuum sealed metal shield, mounted on octal base. Will follow 100 words per minute. Made by BETT & BETT. Brand new in original boxes.

Cat. No. N-201 Your Cost **$2.00**

NIAGARA'S GOLD-PLATED SPECIAL!



An ultra-high freq. Gold-plated Cavity Resonator with a range of 234-258 Mcs! Fully wired, including two 955 acorn tubes. Designed by the navy for use as a portable modulated test oscillator. CAN BE USED AS A MODULATED SIGNAL GENERATOR. Battery compartment is large enough to house speech equipment, and power supply, making it a desirable portable UHF Transmitter for Ham use. Complete with tuning wrench, tubes, whip antenna, and circuit diagram on inside cover. Black wrinkle finished cabinet measures 9½ x 6½ x 6¾".

The Buy of a Lifetime!

Cat. No. N-257 SPECIAL **$3.95**

BARGAINS IN NEW METERS

N-197	2" Rd. G. E. 0-10 D.C. Amps.	$1.96
N-198	3" Rd. G.E. 0-10 D.C. Amps (Adapt. Flanged)	2.25
N-199	3" Rd. Weston 0-800 Ma. D.C.	3.95
N-200	3" Rd. Asst'd brands 0-4 KV. D.C. *	1.96
N-231	2" Rd. Asst'd brands 0-1 R.F. Amps.	1.96
N-232	4" Rd. W.F. 50-0-50 Yds. per sec. (0-1 ma)	3.95
N-233	3" Rd. G.E. 0-30 KV. D.C.	2.65
N-234	3" Rd. —6 to +100 DB. (0-1 ma. basic), illum.	1.95
N-235	3" Rd. McClintock 0-2.5 R.F. Amps.	1.96
N-236	3" Rd. McClintock 0-1 Ma. D.C.	3.45

*N-230 Shunt available at **$1.00** each

CONDENSERS

Cat. No.	Cap.	Voltage	Each
N-146	500	12	$ .59
N-147	1000-1000	15	1.95
N-148	1000	25	.98
N-149	6&3	600	.89
N-150	4	450	.79
	8	300	
N-151	16-16	150	.49
	10	25	
N-152	3x.25	600	.71
N-153	1	3500	.98
N-154	2x.6	25	.98
N-155	2	330AC	.69
N-156	1	440AC	.69
N-157	2	440AC	.69
N-158	4	400	.95
N-159	.1	7500	3.95
N-160	.2	600	.89
N-161	1	1000	1.19
N-175	4	600	.95
N-162	6	600	.98
N-163	.25	4000	3.95
N-164	6	330AC	.75
N-165	2-4-8	400	.59
N-166	10	400	.98
N-167	2	1000	.98
N-168	4	1000	1.95
N-169	4	1500	2.10
N-170	6	1500	2.89
N-171	1	2500	2.25
N-172	.5	3000	1.75
N-173	1	3500	2.25
N-174	.2	5000	2.95

Niagara Radio Supply Corp.

Phone Digby 9-1132-3-4

Dept. E119 160 Greenwich Street, New York 6, N. Y.

RELIANCE SPECIALS

POWER RHEOSTATS
STANDARD BRANDS

25 WATT

Resist.	Shaft	Pr.
10Ω	¼"	.49
15	¼"	.59
25	S.D.	.49
35	¼"	.59
50	¼"	.49
145	¼" with switch	.49
200	¼"	.49
250	¼"	.59
370	¼"	.49
1,500	¼"	.49
2,500	S.D.*	.69
3,500	¼"	.69
5,000	S.D.*	.69

50 WATT

2	¼"	.69
6	¼"	.69

50 WATT

8Ω	S.D.*	.69
12	¼"	.69
20	¼"	.69
50	¼"	.69
90	¼"	.59
123	¼"	.59
1,250	¼"	.79
2,000	¼"	.79
3,500	¼"	.59

100 WATT

2Ω	½"	1.29
10,000	S.D.*	1.49

150 WATT

8Ω	½"	1.99
75	½"	1.99

300 WATT

150Ω	2"	3.95

*S.D.—Screw Driver Slot

FLUORESCENT BLACK LIGHT. 115V., 60 Cyc. Ballast & 4 Watt Black light Tube. Only..... $1.59

ARC 5. Receivers BC 454 - BC 455. Used. Good cond. W/tubes..... $6.95

WIRE WOUND PRECISION RESISTORS, 1% OR BETTER

¼ WATT—25c

6.68Ω	12.32Ω	16.37Ω	123.8Ω	414.3Ω
10.48	13.02	20	147.5	705
10.84	13.52	62.54	220.4	2193
11.25	13.89	79.81	301.8	10,000
11.74	14.98	105.8	366.6	59,148

½ WATT—25c

.250Ω	11.10	235Ω	4,451Ω	15,000Ω
.334	13.15	260	5,000	15,750
.502	46	270	5,900	17,000
.557	52	298.3	6,500	30,000
.627	55.1	400	7,000	100,000
1	75	723.1	7,500	150,000
1.01	97.8	2,500	8,000	
1.53	125	2,850	8,500	
2.04	180	3,427	14,825	
	210	4,000		

1 WATT—30c

1.01Ω	5.05Ω	10.9Ω	3,300Ω	18,000Ω
2.58	5.21	270	7,000	55,000
3.39	10.1	1,250	9,000	55,000
				70,000

1 WATT—40c

100,000Ω	128,000Ω	180,000Ω	522,000Ω
120,000	130,000	320,000	600,000
125,000	160,000	470,000	700,000

1 Megohm—1 Watt 1%—65c; 5%—40c

Orders for 100 pieces—10% off;
Orders for 1,000 pieces—20% off.

CAPACITORS
POSTAGE STAMP MICAS

MMF	MMF	MMF	MMF	MMF	MFD	MFD
8.2	39	82	250	510	.001	.003
10	40	90	300	560	.0012	.0033
18	47	100	330	580	.0013	.0039
20	50	110	350	600	.00135	.0047
22	56	150	370	620	.00136	.005
24	60	160	400	650	.0015	.0068
25	62	220	470	680	.002	.008
26	75	240	500		.0026	.0082
					.0027	.01

Price Schedule

8.2mmf to .001mfd 5c
.0012mfd to .002mfd 7c
.0027mfd to .0082mfd 12c
.01mfd 18c

SILVER MICAS

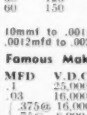
MMF	MMF	MMF	MMF	MMF	MFD	MFD
10	82	180	390	525	.001	.0033
24	68	200	395	560	.0012	.0039
25	68	208	400	600	.0013	.004
30	75	240	430	620	.0015	.0047
39	100	250	466	665	.002	.005
40	116	300	470	680	.0022	.0051
47	120	330	488	700	.0024	.01
50	125	360	500	750	.0027	
60	150	370	510	820	.003	

Price Schedule

10mmf to .001mfd 10c
.0012mfd to .0027mfd 20c
.003mfd to .0051mfd 50c
.01mfd 65c

Famous Makes—OIL FILLED—Brand New

MFD	V.D.C.	Price
.1	25,000	$14.95
.03	16,000	1.70
.375	16,000 and 7,500	
.75	8,000 (dual)	5.95
.5	7,500	23.95
.1	2,500	1.35
.1-.1	7,000	1.35



2 mfd. 4,000 V. D. C. #23F47 SPECIAL $4.50

MFD	V.D.C.	Price
.1	7,000	$1.30
.02-.02	7,000	.90
1	6,000	8.50
1	6,000	1.75
.03-.03	6,000	1.65
2	4,000	4.50
.25	3,000	1.75
.2	750 V.A.C. (2,200 V.D.C.)	.39
1	2,000	.95
4	1,000	.90
3	1,000	.80
2	1,000	.65
1	800	.40
10	600	1.00
4	600	.69
2	600	.39

Wrapped—BALL BEARINGS—New

Mfg.	ID	OD	Width	Price
Fafnir 33K5	3/16"	1/2"	5/32"	.25
N.D. 38	5/16"	7/8"	9/32"	.45
Fafnir K8A	1/2"	1 1/8"	5/16"	.60
N.D. 3201	15/32"	1 1/4"	3/8"	.60
N.D. 5202C13M	1/2"	1 3/8"	1/8"	1.00
Fafnir 7308W	1 37/64"	3 9/16"	5/16"	2.70
SKF 466430	6"	8"	1"	5.00
SKF 170645	3 11/32"	4 1/8"	7/16"	1.50
Fafnir K37B	2 5/16"	3 1/16"	11/32"	1.00
Fafnir 545	2 1/16"	2 5/8"	15/32"	1.00

NEEDLE BEARINGS

B108 1/2" wide	5/8"	13/16"	30¢
GB34X 1 1/4" wide	3/16"	11/32"	25¢

TIME DELAY RELAY

Raytheon CPX 24166
KS 10193-60 Sec.

- 115 V., 60 Cycle
- Adj. 50-70 Seconds
- 2½ seconds recycling time, spring return
- Micro Switch Contact, 10A
- Holds On as long as power is applied. Fully Cased

ONLY $6.50

UNIVERSAL JOINT
ALUMINUM
1⅛" long x ½" O. D. ¼" ID
ONLY 40c

ST'D PRECISION POTENTIOMETERS

6 WATT

20,000Ω	314A	$1.70
20,000	314A	2.50
6,000	260	1.70
6,000	314A	1.70
5,000	314A	2.50
5,000	314A	2.50
5,000	214A	1.40
2,000	260	1.70
600	314A	2.25
200	314A	1.40

4 WATT

500Ω	48-501	5.90
50	301	1.10
25	301	1.10
20	292	.75
20	301	1.10
12	301	1.10

12 WATT

10,000	271T	$2.00
5,000	271T	2.00

—FUSE HOLDER—

LITTLE FUSE No. 342001, 3AG size, finger..... 18¢
3AG (same as above)..... 20¢

PULSE TRANSFORMERS

X 124 T2, UTAH, marked 9262 or 9280, small gray case 1⅞" high x 1⅝" x ⅝" with two 6-32 mtg. studs. Ratio 1:1:1, hypersil core..... $1.50

D161310, 50 Kc to 4 Mc, 1⅝" dia. x 1⅝" high. 120 to 2350 ohms..... $3.00

352-7128—Spec. 16, 111 Chicago Trans., equivalent to 9262 (above)..... $1.50

TR 1048 Dinion Coil Co...... $1.25

TR 1049 Dinion Coil Co...... $1.25

352-7250-2A, cased 16 16" dia. x 1⅝" high. Dc 10 ohm, 3½ ohm, 140 cy. to 175 KC..... $1.25

352-7251-2A, similar, shorter pulses..... $1.25

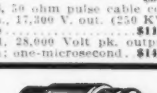
KS8900, Ratio, 1.1:1, 2:1, Freq. range 380 to 520 C.P.S..... $3.50

D106173, W. E. Freq. response 10KC to 2 MC..... $9.80

300 KVA GE 7557296, 50 ohm pulse cable connection; 3,850 V. in., 17,300 V. out. (250 KVA 6 x 4 microseconds)..... $11.75

800 KVA G.E. K2731, 28,000 Volt pk. output; Bitliar, pulse width; one-microsecond..... $14.50

SELSYNS



115 V., 60 Cyc.
3¼" dia. x 4½" body
#C78248
$7.25 pair

DIFFERENTIAL

115 V., 60 Cyc.
#C78249
$2.25 ea.

Used between two 2C78248's as dampener. Can be converted to a 3600 RPM Motor in 10 Minutes. Conversion sheet supplied.

Mounting Brackets — (Bakelite) for selsyns, and differentials shown above. **25c pair**

GLYPTAL CEMENT, ½ gal. **$11.00,** 1 gal. **$2.50**
1 qt..... 75¢

RG 8/U 52 OHM

10,000 ft. & over..... $47.50 per M
1,000 ft. to 9,999 ft... 50.00 per M
Smaller quantities ..... 6¢ per ft.
RG 22/U 95 OHM (2 cond.) per 1,000 ft. $120.00
RG 62/U 93 OHM per 1,000 ft..... $50.00

COAXIAL CABLE CONNECTORS

Angle Adapter 15c	Plug 28c	Socket 28c	Head 9c
M-359	PL-259A	SO-239	83-1H
83-1AP	83-1SPN	83-1R	

Adaptor for PL-259 A for use on small coax. 12c each..... $10.00 per 100

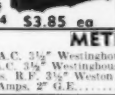
83-1SP	$.28	UG 21/U	.60	UG 60/U	.60
83-1J	.80	UG 22/U	.60	UG 61/U	.60
83-1T	1.12	UG 24/U	.60	UG 85/U	.60
83-22AP	.85	UG 25/U	.60	UG 87/U	.50
83-22J	.85	UG 27/U	.60	UG 167/U	2.00
83-2J	1.50	UG 59/U	.60	UG 281/U	.60
UG 13/U	.60				

JONES BARRIER STRIPS

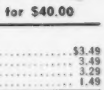
Type	Price	Type	Price	Type	Price
2-140Y	$.65	5-141	.19	17-141Y	.78
3-140	.19	5-141½W	.27	2-142	.11
4-140	.13	5-141Y	.25	2-142½W	.15
4-140½W	.17	6-141	.23	3-142	.15
4-140Y	.17	6-141½W	.37	4-142	.19
5-140Y	.21	7-141	.27	5-142	.21
6-140	.18	7-141½W	.37	6-142	.28
6-140Y	.25	7-141Y	.37	6-142½W	.40
7-140	.21	8-141½W	.38	7-142	.32
8-140	.23	9-141	.37	9-142	.41
9-140	.43	9-141½W	.47	10-142	.45
10-140½W	.41	9-141Y	.42	10-142½W	.58
10-140Y	.40	10-141½W	.47	10-142Y	.64
11-140	.36	10-141Y	.52	11-142	.48
11-140½W	.44	11-141	.40	11-142½W	.57
13-140	.36	11-141Y	.57	12-142	.53
15-140Y	.59	12-141	.43	13-142	.57
13-141½W	.17	12-141½W	.61	13-142½W	.52
4-141W	.22	13-141½W	.67	15-142½W	.94
4-141½W	.22	14-141½W	.72	2-150	.28
4-141Y	.22	16-141Y	.77	4-150	.52

0-15A BASIC MOVE. 12 Ma. 5" x 4" METAL CASE MIRROR SCALE Lots of 10—$34 $3.85 ea

DC AMMETER



CHOKE
400 MA 12 Hy. 90 OHM 6,000 V. D. C. TEST $3.85



10 for $40.00

METERS

0-7.5 V.A.C. 3½" Westinghouse..... $3.49
0-15 V.A.C. 3½" Westinghouse..... 3.49
0-8 Amps. R.F. 3½" Weston..... 3.29
60-0-60 Amps. 2" G.E..... 1.49

TOGGLE SWITCHES

Bat Handle, S.P.S.T. 6A., 125V. Off On plate..... 20¢
Bat Handle, S.P.D.T., 6A., 125V..... 24¢
Bat Handle, D.P.S.T., 6A., 125V..... 29¢

HAYDON TIMING MOTOR. 110V., 60 Cyc. 2/3 R.P.M. Two connected on one shaft to make unit reversible. Only..... $4.95

CHROMALUX STRIP HEATER. 115 V.A.C., 60 Cyc., 750 Watt. Curved, 20" x 1¼" Only..... 95¢

HARDWARE ASSORTMENT (mostly 6-32) screws, nuts, washers, rivets..... 3 lbs. $1.00

BRASS BINDING POST. Eby, screw down with 832 mounting screw..... Per 100 $3.95

RANGE UNIT

From AN/APS-15. Contains 11 Utah X-124-T2 (9280) Pulse Transformers, 12 Prec. Resistors, 28 V.D.C. Blower, metal cabinet, and other useful parts..... **SPECIAL $10.95**

SPAGHETTI SLEEVING — Asst. sizes & colors. 3 ft. lengths, 99 ft..... **ONLY $1.00**

POWER TRANSFORMER, Pri. 110/220/440, 60 Cyc., 2 Sec. Windings each 300V., 4 Amp..... **SPECIAL $9.95**

ALLEN SET SCREWS

4-40 x 1/8	6-32 x 1/8	8-32 x 5/16
4-40 x 3/16	6-32 x 1/8	8-32 x 3/8

ALL SIZES (Cup Point)..... **$1.50 per 100**

BC-1072-A TRANSMITTER

115V., 60 Cyc.; 150-200mc. Power supply gives 0-3,000 V.D.C. (Variac control), 212 and 700 V.D.C., 6.2 V.A.C. also contains blower 115 V.A.C., 5 KV meter, condensers, tubes, relays and many other useful parts. Shipping Wt., 245 lb..... **ONLY $22.50**

Minimum Orders $3. All orders f.o.b. PHILA., PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. *Telephone RIttenhouse 6-4927*

GUARANTEED BRAND NEW

LECTRONIC RESEARCH TUBE SPECIALS

STANDARD BRANDS ONLY

RECEIVING TUBES															
OZ4	.59	5Y4G	.46	6K8GT	.79	7H7	.72	30 Spec.	.48	3EP1	2.92	1B26	4.50	203A	6.48	829	3.95
OZ4G	.59	5Z3	.59	6L6	1.22	7L7	.79	31	.62	3HP7	4.91	1B36	4.50	203B	8.35	832A	4.91
1A3	.85	5Z4	.79	6L6G	1.11	7N7	.79	32	.99	4AP10	5.35	1H20	.58	204A	27.99	836	.89
1A5GT	.84	6AB7/1853	.99	6L6GA	.87	7S7	.96	33	.99	5AP1	3.75	2B22	1.41	WE-205F	2.85	836A/3B27	1.29
1A7GT	.69	6AC5GT	.94	6P7G	1.28	7V7	.96	34	.99	5AP4	4.75	2C22	.22	CE-206	2.95	837	1.18
1AB5	.73	6AC7/1852	.79	6Q7	.69	7W7	.96	35/51	.72	5BP1	1.89	2C26	.27	211	.62	838	2.92
1B3GT/ 8016	1.18	6AD6G	.79	6R7	.89	7Y4	.65	35A5	.65	5CP1	2.87	2C34/RK-34	.28	WE-215A	.24	841	.49
1B4P	1.15	6AD7G	1.13	6SA7GT	.52	12A6	.24	35L6GT	.59	5CP7	3.76	2C44	.79	WE-231D	1.25	843	.88
1C5GT	.96	6AE6G	.72	6SB7Y	.79	12A7	1.16	35Z3	.65	5FP7	.87	2E22	1.25	WE-245A	1.35	852	6.48
1C6	.94	6AG5	.89	6SC7	.66	12AH7GT	.72	35Z5GT	.65	5HP4	2.90	2J21A	8.95	WE-249C	1.88	860	2.44
1D5GP	1.04	6AG7	1.19	6SD7GT	.79	12AT6	.59	37	.59	5JP4	9.55	2J22	8.95	WE-257A	2.77	861	17.70
1D8GT	1.05	6AJ5	.89	6SF5	.59	12AT7	.99	38	.64	5MP1	10.65	2J51	3.89	WE-259A	4.22	864	.19
1E5GP	1.16	6AK5	.89	6SF5GT	.59	12AU6	.72	39/44	.69	5MP5	10.65	2K25	23.95	WE-271A	6.75	866A	.95
1E7G	.66	6AK6	.82	6SF7	.72	12AU7	.86	41	.59	7BP1	12.87	2X2/879	.49	WE-274B	1.06	872A	1.88
1G4GT	.79	6AL5	.69	6SG7	.69	12AX7	.86	42	.59	7BP14	14.95	2X3A	.79	WE-283A	1.27	874	1.65
1G6GT	.79	6AD5	.72	6SG7GT	.68	12BA6	.64	43	.59	9LP7	3.88	3B22/EL-IC	1.12	WE-293A	3.36	878	.39
1H4G	.69	6AQ6	.65	6SH7	.44	12BE6	.64	45	.59	985	4.47	304TH	3.86	954	.39		
1H5GT	.89	6AT6	.54	6SH7GT	.43	12C8	.59	45Z5GT	.65	10FP4	29.95	3B24	1.07	304TL	.89	955	.39
1J6G	1.04	6AU6	.72	6SJ7	.59	12F5GT	.65	46	.84	12GP7	12.85	3B27/836A	1.29	WE-311A	5.80	956	.49
1L4	.66	6AV6	.58	6SJ7GT	.59	12H6	.39	47	.86	Photo Cells		3C24	.44	WE-313CD	1.65	957	.49
1LA4	.94	6B4G	.94	6SK7	.59	12J5GT	.49	50	1.41	CE-1C/918	.88	3E29	4.91	316A	.66	958A	.49
1LB4	.94	6B8	.79	6SL7GT	.69	12K8	.69	50A5	.79	1P24	.29	SN-4/631-P1	3.77	WE-328A	1.80	959	.29
1LC6	.73	6B8G	.79	6SN7GT	.64	12Q7GT	.59	50B5	.69	927	1.67	WE-329A	1.45	1005	.24		
1LD5	.94	6BA6	.65	6SQ7	.53	12SA7	.59	50L6GT	.57	1645	1.67	4A1	.58	WE-348A	2.69	1201A/7E5	.29
1LE3	.73	6BE6	.65	6SQ7GT	.53	12SC7	.69	55	.79	Thyratrons		4B24/EL-3C	2.44	350A	1.10	1203/7C4	.19
1LH4	.94	6BG6G	1.72	6SR7	.59	12SF5	.65	56	.59	OA4G	.95	4B25/EL-6CF	8.78	WE-356B	4.45	1294/1R4	.29
1LN5	.88	6BH6	.72	6SS7	.65	12SF7	.69	57	.59	RL-C1A	3.35	4C28	8.85	371B	.82	1299/3D6	.29
1N5GT	.69	6BJ6	.72	6ST7	.79	12SG7	.69	58	.59	RK55B	.18	4D21	26.50	446B	1.29	1613	.61
1N6G	.72	6C4	.21	6T7G	1.15	12SH7	.69	75	.59	L55B	.18	5R4GY	1.05	5S-501	14.70	1616	.87
1P5GT	.59	6C5	.60	6U5/6G5	.72	12SJ7	.49	76	.59	2D21	1.18	5U4G	.49	5S-502	14.70	1619	.19
1Q5GT	.94	6C6	.69	6U7G	.65	12SJ7GT	.49	77	.59	3C23	3.20	5V4G	.59	507AX	1.47	1619	.19
1R4	.29	6C8G	.89	6V6	1.07	12SK7	.59	78	.59	4C35	19.77	5X4G	.59	531	17.80	1624	.69
1R5	.69	6D6	.59	6V6G	.59	12SK7GT	.59	79	.59	EL-C5B	8.95	5Y3GT	.38	HK-24G	.44	1625	.19
1S5	.64	6DSG	.87	6V6GT	.59	12SL7GT	.69	80	.59	C6J	4.41	6K8GT	.83	561	1.45	1626	.29
1T4	.64	6E5	.79	6W7G	.79	12SN7GT	.79	81	.59	FG-17	2.89	7H7	.92	RK-25	2.11	1628	.29
1T5GT	.64	6F5	.69	6X4	.59	12SQ7	.59	82	.77	FG-33	11.95	7L7	1.24	579B	5.85	1629	.29
1V	.69	6F5GT	.60	6X5GT	.59	12SR7	.69	83	.79	FG-67/ 1904	8.85	7N7	.79	RK-34/ 2C34	.28	HY-615	.29
2A3	.89	6F6	.69	6Y6G	.88	14A4	.88	84/6Z4	.65	FG-81A	4.95	7S7	.96	705A	1.17	702B	3.87	1630	3.11
2B7	.79	6F7	.72	6Z7G	1.09	14A7/12B7	.79	89Y	.55	FG-172	14.50	7V7	.96	REL-36	.78	707A	5.22	1636	3.77
2X2/879	.49	6F8G	.89	6ZY5G	.79	14B8	.79	117L7GT	1.34	WE355A	14.15	7W7	.96	RK-47	4.92	707B	6.95	1641/RK-60	.59
2X3A	.79	6G6G	.88	7A4/XXL	.65	14C5	.79	117P7GT	1.24	394A	3.77	7Y4	.65	VT-52	.36	715A	6.95	1644	.89
3A4	.61	6H6	.49	7A6	.65	14H7	.79	117Z3	.54	KU-610	5.35	12A6	.24	53A	3.82	715B	4.85	1960	1.21
3A5	.96	6H6GT	.48	7A7	.65	14J7	.89	117Z6GT	.87	KU-634	17.20	12AT6	.59	RK-60/1641	.59	715C	6.75	UX-4653	.65
3B7/1291	.29	6J5	.49	7AD7	.95	14N7	.89	1164Z4	.65	WL-652/ .657	38.00	12AU6	.72	VR-90/OB3	.81	715P	6.95	7193	.22
3C6 (XXB)	1.18	6J5G	.48	7AG7	.79	14W7	.96	1172	.54	884	1.35	12AU7	.86	C1000E	2.30	717A	.92	8012A	1.91
3D6/1299	.29	6J5GT	.48	7AH6	.65	14X7	.96	1177Z3	.54	885	.89	12AV6	.58	WE-101D	1.65	721A	3.93	8013	.92
3Q4	.69	6J6	.89	7B4	.65	16	1.16	1177Z6GT	.87	1614S	.97	12AX7	.86	WE-101F	3.42	724B	3.22	8013A	1.42
3Q5GT	.79	6J7	.72	7B6	.64	22	1.16	UV199	.52	1904	8.85	12BA6	.64	VR-105/ 0C3	.72	801A	6.87	8020	1.18
3S4	.61	6J7GT	.71	7C4	.19	24A	.66	FM-1066	.97	2050	.83	12BE6	.64	807	1.15	8020	1.39
5AZ4	.48	6J8G	.96	7C5	.64	25L6GT	.59	Cathode Ray Tubes		2051	.49	WE-113A	1.32	808	2.19	9002	3.17
5R4GY	1.05	6K5GT	.86	7C7	.65	25Z5	.55			Transmitting & Special Purpose Tubes		WE-120A	4.47	810	6.55	9003	.42
5T4	.89	6K6GT	.52	7E5	.29	25Z6GT	.49	3AP4/ 1852	5.94			WE-121A	1.97	811	1.71	9004	.39
5U4G	.59	6K7	.54	7F6	.64	26	.59	906P4	5.94			WE-124A	3.89	813	6.95	9006	.29
5X4G	.59	6K7G	.54	7F7	.79	27	.49	3BP1	2.59	OA2	1.32	VT-127A	2.40	814	3.79	189048 (6A-Tungar)	3.15
5Y3GT	.38	6K8	.83	7F8	.92	28D7	.61	3CP1	1.77	1B24	4.90	VR-150/ OD3	.72	815	1.72		
														826	.57		

ALLEN - BRADLEY
TYPE "J" POTENTIOMETERS

100 (SS)	10K	25K
500	10K (SS)	25K (SS)
1000 (SS)	15K (SS)	50K (SS)
5000 (SS)	20K (SS)	60K
100K	250K (SS)	
100K (SS)	500K (SS)	
150K	1meg. (SS)	
200K (SS)		

All shaft lengths min. 3/8" except where marked (SS) —screw-slot ..... 38¢ each

COAXIAL CONNECTORS

83-1AP	.09	UG-30/U	.94
83-1H	.10	UG-33/U	14.80
83-1J	.68	UG-34/U	12.80
83-1R	.28	UG-36/U	12.40
83-1RTY	.45	UG-37/U	12.40
83-1SP	.28	UG-58/U	.57
83-1SPN	.28	UG-85/U	.62
83-1T	1.12	UG-86/U	1.22
83-22AP	.48	UG-87/U	.68
83-22F	.88	UG-171/U	1.33
83-22R	.52	UG-176/U	.16
83-22SP	.48	UG-180A/U	3.82
UG-7/AP	2.14	UG-191/AP	.57
UG-12/U	.63	MX-199/U	.41
UG-21/U	.67	UG-197-U	1.33
UG-22/U	.86	UG-206/U	.58
UG-23/U	.63	UG-254/U	.88
UG-24/U	.67	UG-255/U	.82
UG-27/U	.68	UG-264/U	1.74
UG-29/U	.83	MX-367/U	.15

RCA HI-VOLTAGE TRANSFORMER

Pri—115/230V. 60Cy
Sec—6000V—80 MA

$11.80

Insulated for Voltage Doubler Use

GENERAL ELECTRIC FG-172 THYRATRONS

$14.50 EA.

$10.00 EA.

IN LOTS OF 10
BRAND NEW
ORIGINAL CARTONS
FULLY GUARANTEED

ASB YAGI ANTENNA

ADJUSTABLE STUB TUNING

5 ELEMENT ROTATABLE ARRAY— **$7.00**
450 TO 560 MC

SAME EXCEPT DOUBLE STACKED 6 ELEMENT
450 TO 560 MC

$12.70

Same Except Double Stacked
6 Element
370 to 430 MC

$29.40

WESTINGHOUSE HYPERSIL TRANSFORMER

PRI-115V. 60CY ¾ KVA
SEC #1 - 240V - 1.56A
SEC #2 - 240V - 1.56A
WT. 30 LBS.

$11.50 EACH

$10.00 ea. Lots of 10

FILTER CHOKES

10H	65 MA	460 ohm	herm. sealed	.79
9H	85 MA	260 ohm	Thordarson T13C29	.76
15H	125 MA	500 ohm	strap. mtg.	1.22
10H	150 MA	100 ohm	herm. sealed	1.55
15/29H	150 MA	200 ohm	swinging	1.89
4H	175 MA	100 ohm	Stancor C-1410	1.95
10H	200 MA	80 ohm		2.92
10H	350 MA	65 ohm		3.95
Dual 1H	400 MA	22 ohm	herm. sealed	1.77
10H	400 MA	90 ohm	Acme herm. sealed	3.77
1.75/8H	600 MA	13 ohm	RCA	5.76
.2/.9H	3.45A	1.1 ohm	Amertran 20KV insul	16.95
.02H	5A	0.2 ohm	1780 V insul.	3.95
.03H	7A	0.2 ohm	1780 V insul.	5.25

FILAMENT TRANSFORMERS

(All 115V 60cy primary except where noted)

UTC	herm. sealed	5V @ 1A	1.22
UTC	herm. sealed	6.3V @ 0.6A	1.33
UTC	herm. sealed	6.3V @ 3.2A	2.21
Raytheon	herm. sealed	6.3VCT @ 0.6A	1.35
Raytheon	herm. sealed	6.3VCT @ 3A, 6.3V @ 0.5A	2.31
G.E.—6.3V @ 13A, 6.3V @ 1.2A			3.82
Pri. 115/230V—Sec. 11V @ 15A-25KV insul.			48.60
Pri. 115/230V—Sec. 9VCT @ 35A			17.65
Amertran—5V @ 190A—35KV insul.			19.50
6.3VCT @ 5A, 6.3VCT @ 2A, 6.3VCT @ 2A, 2½VCT @ 5A, 2½VCT @ 5A			4.77

Antennas for AN/APR-4 Receivers

AT-38A/APT—(70 to 400 MC) $13.70
AT-49/APR-4—(300 to 3300 MC) $13.70

G. E. LIQUID LEVEL TRANSMITTER

Consists of Model 8T313 position transmitter (360° wound potentiometer) coupled by means of a pair of Alnico magnets through a hermetically sealed diaphragm to a cork float at the end of a linkage system. Gov't cost $76.00

OUR PRICE $2.44

TRANSFORMERS

(All 115V 60cy prl. except where noted)

2240VCT @ .74 KVA -10KV insul.	$28.70
Pri. 115/230 - Sec. 500/500V @ 4A, 400/400-300/300 @ 5A	67.50
1120 VCT @ 150 MA Thord. T19P54	4.91
1000VCT @ 200 MA, 2000V @ 10MA, 5V @3A, 2½V @ 2A, 6.3V @ 1A, 12.6VCT @ 4A	7.88
800VCT @ 200 MA, 6.3V @ 6A, 5V @ 4A	4.18
1040VCT @ 120 MA, 6.3VCT @ 5A, 5V @ 2A	4.90
710VCT @ 85 MA, 6.3V @ 4A, 5V @ 2A	2.22
Same as above except pri. 110/125/150/210/240V 50-60cy	2.72

AT-48/UP 3 CM HORN

$3.95 Ea., 10 for $35.00

All material brand new and fully guaranteed. Terms 20% cash w/ order, balance C. O. D. unless rated. All prices F.O.B. our warehouse, Phila., Penna.

LECTRONIC RESEARCH LABORATORIES

1021-23 CALLOWHILL ST. PHILA. 23, PA.

Telephones - MARKET 7-6590 and 6591

WELLS RADIO-ELECTRONIC Components by the Thousands!

TOGGLE AND PUSH SWITCHES

FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. I FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACT	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	TYPE LEVER	MOUNTING DATA	UNIT PRICE
370-1	A	5a - 125v.	SPST MOMENTARY	CH 1A-3032-MS	BAT ⅛	1-13.16 MTG.C.	$0.35
370-4	A	5a - 125v.	SPDT CENTER OFF	CH B-96	BAT ⅛	1-13.16 MTG.C.	.35
370-14	A	5a - 125v.	SPDT CEN. OFF 1 SIDE MOM.	CH B-76	BAT ⅛	1-13.16 MTG.C.	.35
370-25	A	5a - 125v.	SPST MOMENTARY	CH B-48	BAT ⅛	1-13.16 MTG.C.	.25
370-100	A	5a - 125v.	SPDT CENTER OFF	CH 1A-3021-LB	BAT ⅛	1-13.16 MTG.C.	.39
1T-102	A	5a - 125v.	SPST MOMENTARY	CH 501582	BAT ⅛	1-13.16 MTG.C.	.30
1T-103	A	5a - 125v.	SPST	CH B-84	BAT ⅛	1-13.16 MTG.C.	.30
1T-106	A	20a - 28v	SPST 1 SIDE MOMENTARY	CH 6000B360	BAT ⅛	1-13.16 MTG.C.	.35
1T-109	B	5a - 125v	SPST MOMENTARY	CH B-10	BAT w/SEM	1-13.16 MTG.C.	.45
302-68	C	20a - 125v	DPST	CH 1A-3023-2	BAT ⅛	1-13.16 MTG.C.	.45
308-152	C	20a - 125v	DPST CEN. OFF MOMENTARY	CH C-11	BAT ⅛	1-13.15 MTG.C.	.50
308-152	C	20a - 125v	DPST	CH C-1	BAT ⅛	1-13.15 MTG.C.	.45
308-156	C	20a - 125v	DPST MOMENTARY	CH 671182	BAT	1-13.15 MTG.C.	.40
370-31	C	20a - 125v	DPST	CH C-18	BAT ⅛	1-13.15 MTG.C.	.55
308-67	D	5a - 125v	1 SIDE DPST MOM 1 SIDE SPST ASSN		BAIL	9-32 BUSHING	.95
308-111	F	5a - 125v	SPST MOMENTARY	CH 501762	BAT ⅛	7 16-32 BUSHING	.28
308-153	H	3a - 125v	SPDT CENTER OFF	CH 1A-3021-LB	BAT ⅛	7 16-32 BUSHING	.39
1T-100	G	3a - 250v	SPST	CH	BAT	7 16-32 BUSHING	.22
1T-101	F	5a - 125v	SPST MOMENTARY	ASSN w LEADS	BAIL	7 16-32 BUSHING	.20
301-51	G	5a - 125v	SPDT MOMENTARY	CH 500A314	BAT ⅛	1-13.16 MTG.C.	.75
1T-108	G	20a - 125V	DPDT	CH 6764AB	BAT	16 x 8 MTG.C.	.60
308-140	H	3a - 125v	DT NO MAKE EACH SIDE	OPEN FRAME	BAIL	2 9-32 BUSHING	.25
308-161	L	30a - 125v	SPST	CH 678183	BAT ⅛	1-13.16 MTG.C.	1.95
301-12	L	30a - 125v	DPST		BAKELITE	2-3 M MTG.C.	1.25
308-76	L	30a - 125v	DPST		ASSN OPEN FRAME BAKELITE	3-1.4 MTG.C.	.75
301-12	M	3a - 125v	DPST		ASSN SPECIAL FOR HANDY TALKIE	7 16-32 BUSHING	.40
1T-107	H	3a - 250V	DPST		ASSN	SHORT BAT	7 16-32 BUSHING	.20

⅛ INDICATES A LUMINESCENT TIP

FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. K FIG. L FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACTS	MOUNTING DATA	BUSHING LENGTH	KNOB	ADDITIONAL INFORMATION	UNIT PRICE
301-29	A	S.O.	3 8-32 THD.	3 16	BLACK BAKELITE	USED ON MCB-300	$0.15
302-98	A	SPST	3 8-32 THD.	3 8	BLACK BAKELITE		.25
302-75	A	3 MAKE	3 8-32 THD.	3 8	RED SWITCH PLASTIC		.35
303-77	B	S.O.	3 8-32 THD.	3 8	BLACK BAKELITE		.25
303-162	B	DPDT	3 8-32 THD.	3 8	BLACK BAKELITE		.37
303-76	C	DPDT N.C.	7 16-32 THD.	1 2	METAL		.25
370-13	C	S.O.	7 16-32 THD.	7 16	METAL w/ PLASTIC TIP		.25
1P-101	C	S.O.	7 16-32 THD.	1 2	METAL	GENERAL ELECTRIC AN-69	.25
1P-102	C	DPST N.C.	7 16-32 THD.	1 2	METAL	CUTLER HAMMER	.35
1P-103	C	S.O.	7 16-32 THD.	1 2	METAL	MARKED 5A-28 ⅛	.50
308-155	D	S.O.	END OF CORD		BLACK BAKELITE	SIGNAL CORPS 1B-100	.60
370-35	F	S.O.	7 16 MTG.C.		METAL CAP	1B-100 FOR T-17 WIRE	.25
308-108	F	2 MAKE	5 8 MTG.C.		BLACK BAKELITE	CH 6001E300	.35
370-9	F	N.O.				SIGNAL CORPS 1B-161-S	.50
311-77	G	2 N.O.	END OF CORD		BLACK BAKELITE		.30
370-20	H	N.O.	3 8 MTG.C.		BLACK BAKELITE		.25
309-98	E	N.O.	⅝" PRESS FIT		BLACK BAKELITE		.25
370-21	E	N.O.	⅜ 4" PRESS FIT		WHITE PLASTIC	3 SCREW TERMINALS	.35
301-60	I	N.C.	7 16-32 THD.	7 16	BLACK BAKELITE		.35
303-80	I	N.O.	7 16-32 THD.	1 2	BLACK BAKELITE		.35
301-94	W	N.O.	7 8-28 THD.	1 4	BLACK BAKELITE		.18
370-37	W	N.O.	7 8-28 THD.	1 4	WHITE BAKELITE		.18
303-35	W	N.O.	7 8-28 THD.	1 4	BLACK BAKELITE		.15
370-39	N	SPST N.O.	⅜ PRESS FIT		METAL		.20
305-139	-	3 N.O. & 3 N.C.	45 32-32 THD.	1 2	BLACK BAKELITE	ASSEMBLY OF 3 SWITCHETTES	.90
370-3	-	N.O.	½" CABLE CLAMP		GREEN ENAMELED	WITH 3 CONNECTOR CABLE	.90
370-40	-	N.O.	1-13 16 MTG.C.		METAL	SIMILAR TO MICRO SWITCH	.80

Micro Switches

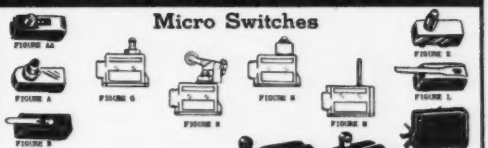


FIGURE AA FIGURE A FIGURE B FIGURE C FIGURE D FIGURE E FIGURE F FIGURE G FIGURE H FIGURE J FIGURE K FIGURE L FIGURE P FIGURE Q

STOCK NUMBER	MANUFACTURER	MFR. TYPE No.	CONTACTS	ILLUSTRATION	TERMINALS	OUTER CASE	PRICE EACH
305-10	Microswitch	MS305	N.C.	FIG. AA	SCREW	Bakelite	$0.40
307-210	"	TP3A	N.O.	FIG. AA	"	"	.50
307-75	"	1T-6491 x	N.O.	FIG. A	SOLDER	"	.40
303-67	"	YZT845	N.O.	FIG. A	SCREW	"	.75
1-1401	"	B-81	N.O.	FIG. A	SOLDER	"	.60
303-46	MI-Switch	MIB-321	SPDT	FIG. B	"	"	.85
303-48	Microswitch	1T-2HTH 1	SPDT	FIG. B	"	"	1.10
303-39	MI-Switch	B-62M	SPDT	FIG. B	"	"	.75
303-78	"	Green Dot	DPDT	FIG. B	"	"	.75
303-79	Microswitch	BZ-RL32	SPDT	FIG. B	"	"	.75
303-154	Arco	324-51	SPDT	FIG. B	"	"	.75
311-115	Microswitch	W2H11	N.O.	FIG. C	SCREW	"	.71
311-113	"	1T302	N.O.	FIG. C	SOLDER	"	.71
311-125	"	W2-78	N.C.	FIG. C	"	"	.90
370-24	"	1T-321	N.C.	FIG. C	SCREW	"	.60
311-114	"	1T52	N.C.	FIG. C	SOLDER	"	.65
306-1	"	1T301	N.C.	FIG. C	"	"	.55
311-116	"	5M-1905	N.C.	FIG. C	"	"	.90
303-4	"	1T2352	DPST	FIG. D	SCREW	"	.68
303-47	"	MB305	SPDT	FIG. D	"	"	.98
303-47	MI-Switch	98B	DPST	FIG. D	SOLDER	"	.75
303-54	Microswitch	W2H12	N.C.	FIG. D	"	"	.75
303-52	"	B-B12	N.C.	FIG. E	"	"	.65
311-25	MI-Switch	C1938155	N.C.	FIG. E	"	"	.80
370-10	Arco	B62M12T	N.O.	FIG. E	SCREW	"	.70
303-58	Microswitch	1Z-1B42T	N.O.	FIG. E	"	"	.75
306-10	"	B2E-2B42T	SPDT	FIG. G	Metal	"	2.40
1305-1010	Arco	B2-2B5221	SPDT	FIG. H	SOLDER	Bakelite	.95
303-74	"	B-5-4565	N.O.	FIG. H	SCREW	"	.75
370-19	Microswitch	1BS01W1BM1	N.O.	FIG. K	"	"	.90
1P-100	Cutler Hammer	5A-941	N.O.	FIG. K	"	"	.65
303-40	Microswitch		N.O.	FIG. K	"	"	.75
303-41	"	BZ-2RWC	N.O.	FIG. L	SOLDER	"	.92
303-44	MI-Switch	B5-11-B42	SPDT	FIG. M	Screw	Metal	1.50
1357	"		N.C.	FIG. N	"	"	1.15
370-15	"	4SB203	SPDT	FIG. N	"	"	1.25
303-76	Microswitch	W2-78ST	N.C.	FIG. N	"	"	1.35
303-31	Arco	4W-31A	N.O.	FIG. P	SOLDER	Bakelite	.37
303-32	"	4W-31B	SPDT	FIG. P	"	"	.37
305-50	Microswitch		Open Type	SPDT	FIG. Q	"	"	.35
370-28	"		1T-3422	N.O.	FIG. Q	SCREW	Metal	2.75

SWITCHETTE

STOCK NO.	MANUFACTURER'S TYPE NUMBER	CONTACTS	TERMINAL LOCATION	UNIT PRICE
303-20	CH 6700E 1003-A2	N.C.	SIDE	$0.47
303-21	CH 6700E 1003-B3	N.O.	END	.47
303-34	CH 6700E 1003-F3	1-N.O. 1-N.C.	END	.47
303-35	CH 6700E 1003-F4	1-N.O. 1-N.C.	SIDE	.47
303-14	CH 6700E 603-B3	N.O.	SIDE	.47
303-15	CH 6700E 1421-B3	N.O.	SIDE	.47
303-22	CH 6700E 1421-F3	1-N.O. 1-N.C.	END	.47
303-23	CH 6700E 1421-J22	N.C.	SIDE	.47
303-42	CH 6700E 1421-14	SPDT	END	.47
303-17	CH 6700E 1284-B6	SPDT	SIDE	.47
303-43	CH 6700E 1284-C3	1-N.O. 1-N.C.	END	.47

PRECISION AND POWER CONTROLS

STOCK NO.	RES. OHMS	WATTS	MOUNG DIA.	SHAFT LGTH	MFR.	GENERAL DESCRIPTION	PRICE
321.151	200	6	3"	4"	Ohmite	Meter type precision	$1.25
606.1	100-dual	6	3"	1⅝"	Ohmite	Type K with mtg. nut	1.00
301-90	200	6	3"	¾"	Ohmite	Meter Type	1.25
321.142	5	25	1.9.16"	SD Slot	Ohmite	Type H, knob type bushing	0.96
BH 25	6	25	1.9.16"	SD Slot	Ohmite	Type H	0.96
321.150	7	25	1.9.16"	¾"	Ohmite	Type H	0.96
321.144	10	25	1.9.16"	¾"	Ohmite	Type H	0.96
321.124	50	25	1.9.16"	SD Slot	Ohmite	Type H, knob type bushing	0.96
BH 26	60	25	1.9.16"	SD. Slot	Ohmite	Type H, knob type bushing	0.96
606.5	75	25	1.9.16"	7 16"	Ohmite	Type H	0.96
321.163	100	25	1⅝	¾"	Ohmite	Aircraft AN 3155-25.100	0.96
321.122	100	25	1.9.16"	SD. Slot	Ohmite	Type H25	0.96
321.112	125	25	1.9.16"	7 16"	Ohmite	Type H	0.96
353.111	125	25	1.9.16"	7 16"	Ohmite	Type H	0.96
321.106	150	25	1.9.16"	SD. Slot	Ohmite	Type H	0.96
312.78	100	25	1.7.8"	7 16"	Ohmite	Cockpit lamp type	0.96
606.2	165	25	1.7.8"	7 16"	Ohmite	Cockpit lamp type	0.96
321.127	150	25	1.9.8"	7 16"	Ohmite	Clarostat	0.96
321.62	175	25	1.9.16"	SD. Slot	Ohmite	Type H	0.96
305.146	175	25	1.9.16"	Nar. Sld.	Ohmite	Type H25	0.96
321.164	175	25	1.9.16"	7 16"	Ohmite	Type H	0.96
PH 27	200	25	1.9.8"	7 16"	Ward L.		0.96
321.72	200	25	1.9.16"	7 16"	Ohmite	Type D	0.96
321.141	350	25	1.9.16"	5 16"	Nar. Sld.	Type H25	0.96
321.165	750	25	1.9.16"	7 16"	Ohmite	Type H	0.96
321.143	5K	25	1.9.16"	SD. Slot	Ohmite	Type H	1.10
BH 10	1	50	1.2.8"	1 2"	Meter	Type 433AC, Linear	1.14
321.161	5	50	2.1.2"	7 16"	Nar. Sld.	Aircraft AN 3155.50.5	1.08
321.62	30	50	2.1.2"	7 16"	Ohmite	Type 50A, Aircraft Enclosed	1.08
321.143	5K	25	1.9.16"	SD. Slot	Ohmite	Type H	1.10
BH 28	1.6	50	2.1.2"	7 16"	Ohmite	Aircraft Power Type	1.08
321.124	150	50	2.1.2"	S.D Slot	Nar.Sld.	Type H50 .500 Amps.	1.10
312.71	150	50	2.1.2"	7 16"	Ohmite	Aircraft Type AN 3155.50.150	1.10
353.110	150	50	2.1.2"	S.D Slot	Nar.Sld.	Type H50 .577 Amps.	1.10
321.91	200	50	2.1.2"	7 16"	Ohmite	Aircraft Type AN 3155.50.200	1.10
312.71	200	50	2.1.2"	SD Slot	Nar.Sld.	Type H50	1.10
309.121	500	50	2.1.2"	SD Slot	Nar.Sld.	Type H50	1.10
321.122	500	50	2.1.2"	SD Slot	Nar.Sld.	Type C100	1.10
309.131	5	100	3"	1 2"	Meter	Type K 4.4 Amp.	1.68
309.130	5	100	3"	7 16"	Ohmite	Type C100, 1 Amp.	1.58
353.113	100	100	3"	1 2"	Nar.Sld.	Type C100, 5.10 Amp.	1.58
600.3	10	100	3"	1 2"	Nar.Sld.	Type C100, 15 Amp.	1.58
321.153	1.5	150	4"	1 2"	Nar.Sld.	Type L 4.65 Amps.	2.35
311.158	5	150	4"	7 16"	Ohmite	Type L150 .447 Amp.	2.15
321.155	750	150	4"	1 2"	Nar.Sld.	Type L	2.15
309.123	2350	150	4"	7 16"	Ohmite	Type L .25 Amp.	2.95

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ADJUSTABLE WIRE WOUND RESISTORS

OHMS	WATTS	TYPE	PRICE EACH	OHMS	WATTS	TYPE	PRICE EACH
1	30	Logs	27c	20	10	Logs	17c
2	30	Logs	19c	100	10	Leads	17c
2.75	150	Logs	35c	110	45	Logs	24c
3	10	Leads	13c	200	10	Logs	17c
5	100	Logs	30c	225	50	Logs	29c
10	25	Logs	12c	250	20	Logs	20c
10	30	Logs	19c	750	25	Logs	23c
15	30	Logs	19c	2500	100	Logs	62c
20	10	Logs	11c	2500	25	Logs	34c
30	200	Logs	62c	50	200	Logs	62c
35	50	Logs	32c	1500	50	Logs	34c
50	10	Logs	15c	25K	50	Logs	56c
50	30	Logs	19c	400	20	Logs	20c

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01A	$0.45	6SF5	.65	VT-127A	2.95	714AY	6.95	878	2.15
1B22	6.35	6SG7	.70	VR-150	.55	PR-75B	7.95	931	2.39
1N21 Xtal Diode	.60	6SH7	.60	VR-105	9.00	717A	.95	954	.59
1N21B Xtal Diode	.60	6SJ7-GT	.60	FG-172	29.50	721A	2.95	956	.59
1N23 Xtal Diode	.60	6SK7-GT	.60	2050	1.95	724A	4.00	958	.59
1N23A Xtal Diode	.85	6SL7-GT	.60	211 (VT-4-C)	.65	724B	4.25	957	.59
1N27 Xtal Diode	.80	6SN7-GTA	.60	213A	1.98	725A	19.95	991 (NE-16)	.30
1R5-1294	.65	6SQ7-GT	.60	231D	1.39	730A	19.95	1003	.30
1R6	.95	7A7	.60	243B	4.25	781A	19.95	1146	.30
1R7	.95	7A8	.60	304TH	6.98	801	.60	1201	.75
1S21	1.10	7C4-1203	.60	304TL	7.95	803A	1.95	1203	1.20
1T4	.95	7C5	.60	305A	4.25	803	6.95	1619	.55
2C26	.35	7E6	.60	310A	.75	804	9.95	1620	.45
2C34	.75	7F7	.75	349A	2.98	805	6.40	1621	.45
2C36	.55	7H7	.75	371B	.60	808	2.75	1625	.45
2J27	11.45	7J7	.75	388A	4.98	809	2.75	1629	.45
2J32	9.80	7Q7	.65	417A	19.95	810	7.98	1631	.45
2J42	9.80	7S7	.65	446A	7.49	811	2.25	1632	.45
2J27	14.40	10Y VT-25	.65	446A	1.50	813	7.95	7193	.30
2J31	5.90	12A6	.65	450TH	19.95	814	2.75	7211	2.35
2J48	14.95	12A7-GT	.70	GL-471A	2.75	815	2.98	8013	4.25
2J49	.60	12AH7-GT	.60		15.25	826	.60	9003	.45
3A4	.25	12AT6 2 amp.			7.45	841	.60	9004	.45
3A5	1.60	12AU6	2.25		1.20	843	.60	9006	.45
3AP1 CRT	2.85	13A Ballast	.35		9.95	851	30.00	NEON BULBS FOR RADIO USE	
3BP1	2.95	15E	1.40		9.95	WL-893	2.98		
3D21	1.75	1G-17	2.98		9.95	903	22.00		
3FP1 CRT	3.75	1L-21	2.25		2.98	904	.60	NE-2	$0.05
3GP1 SL	1.98	2D21 Ballast	.45		4.95	905	2.56	NE-15	.06
3J-1-5G	.47	2G6 GT	.60		1.20	906	1.20	NE-16	.06
3J-1-5G	.65	2H7	.60		15.00	909	26.50	NE-21	.06
3KP1 CRT	2.98	3C VT-67 (For			23.25	9005	28.98	NE-23	.06
3MP1 CRT	2.95	Walkie Talkies)	.75		2.15	872A	2.48	NE-48	.24
3RP1 CRT	3.75	3D VT-108 (For			2.15	873	2.15	NE-51	.24
3S4	.90	Walkie Talkies)	.75						
3WP1 CRT	17.95	3N-34	.45						
3AP1 CRT	2.98	3Q	.35						
3BP1 CRT	2.98	3S	.50						
3CP1 CRT	3.95	3V Spec	.50						
3CP1 CRT	3.95	4	.50						
3DP1 CRT	14.25	4D06 VT-21	.65						
3J29	14.20	4E27	1.50						
3J-5G	.90	4J	.90						
4A6	.90	4K-35	.90						
4AC5	.90	4X	.75						
4AU6	.90	5B-24	.60						
4BP1 CRT	2.98	5C	.35						
4BP1 CRT	2.98	5D	.35						
4BP1 CRT	3.95	5J Spec	.50						
4CP1 CRT	14.25	5R4-GY	.60						
4D21	14.20	5U4-G	.60						
4E27	1.50	5V4-G	.60						
4J	.90	5W4	.60						
4K-35	.90	5X4	.60						
4X	.75	5Y3-GT	.60						
5B-24	.60	5Z3	.60						
5C	.35	6A3	.95						
5D	.35	6A4-LA	.60						
5J Spec	.50	6A5-G	.60						
5R4-GY	.60	6A6	.60						
5U4-G	.60	6A7	.60						
5V4-G	.60	6A8-G	.60						
5W4	.60	6AB5	.60						
5X4	.60	6AC7	.60						
5Y3-GT	.60	6AG5	.60						
5Z3	.60	6AG7	.60						
6A3	.95	6AK5	.60						
6A4-LA	.60	6AL5	.60						
6A5-G	.60	6AQ5	.60						
6A6	.60	6AT6	.60						
6A7	.60	6AU6	.60						
6A8-G	.60	6B4-G	.60						
6AB5	.60	6B7	.60						
6AC7	.60	6B8-G	.60						
6AG5	.60	6BA6	.60						
6AG7	.60	6BE6	.60						
6AK5	.60	6C4	.60						
6AL5	.60	6C5-GT	.60						
6AQ5	.60	6C6	.60						
6AT6	.60	6D6	.60						
6AU6	.60	6E5	.60						
6B4-G	.60	6F5	.60						
6B7	.60	6F6-G	.60						
6B8-G	.60	6F7	.60						
6BA6	.60	6G6-G	.60						
6BE6	.60	6H6	.60						
6C4	.60	6J5	.60						
6C5-GT	.60	6J7	.60						
6C6	.60	6K6-GT	.60						
6D6	.60	6K7	.60						
6E5	.60	6L6	2.35						
6F5	.60	6L7	.60						
6F6-G	.60	6N7-GT	.60						
6F7	.60	6P5-GT	.60						
6G6-G	.60	6P7-G	.60						
6H6	.60	6Q7-GT	.60						
6J5	.60	6R7	.60						
6J7	.60	6S7	.60						
6K6-GT	.60	6SA7	.60						
6K7	.60	6SC7	.60						
6L6	2.35	6SD7	.60						
6L7	.60	6SF7	.60						
6N7-GT	.60	11Z3	.60						
6R7-G	.60	VT-127 English	.60						

PILOT AND FLASHLIGHT BULBS

Stock No.	Mazda No.	Volts	Watts	Bulb	Base	Price Each
18-1	40	1.5	.3	G-4½	Min. Screw	$0.10
18-2	44	2.47	.3	G-4½	Min. Screw	.10
18-3	45	2.5	.3	G-4½	Min. Screw	.10
18-4	46	3.6	.3	G-4½	Min. Screw	.10
18-5	47	2.5	.3	G-4½	Min. Screw	.10
18-6	48	3.6	.3	G-4½	Min. Screw	.10
18-7	49	2.5	.3	G-4½	Min. Screw	.10
18-8	50	3.6	.3	G-4½	Min. Screw	.10
18-9	51	2.5	.3	G-4½	Min. Screw	.10
18-10	52	3.6	.3	G-4½	Min. Screw	.10
18-11	53	2.5	.3	G-4½	Min. Screw	.10
18-12	54	3.6	.3	G-4½	Min. Screw	.10
18-13	55	2.5	.3	G-4½	Min. Screw	.10
18-14	56	3.6	.3	G-4½	Min. Screw	.10
18-15	57	2.5	.3	G-4½	Min. Screw	.10
18-16	58	3.6	.3	G-4½	Min. Screw	.10
18-17	59	2.5	.3	G-4½	Min. Screw	.10
18-18	60	3.6	.3	G-4½	Min. Screw	.10
18-19	61	2.5	.3	G-4½	Min. Screw	.10
18-20	62	3.6	.3	G-4½	Min. Screw	.10
18-21	63	2.5	.3	G-4½	Min. Screw	.10
18-22	64	3.6	.3	G-4½	Min. Screw	.10
18-23	65	2.5	.3	G-4½	Min. Screw	.10
18-24	66	3.6	.3	G-4½	Min. Screw	.10
18-25	67	2.5	.3	G-4½	Min. Screw	.10
18-26	68	3.6	.3	G-4½	Min. Screw	.10
18-27	69	2.5	.3	G-4½	Min. Screw	.10
18-28	70	3.6	.3	G-4½	Min. Screw	.10
18-29	71	2.5	.3	G-4½	Min. Screw	.10
18-30	72	3.6	.3	G-4½	Min. Screw	.10
18-31	73	2.5	.3	G-4½	Min. Screw	.10
18-32	74	3.6	.3	G-4½	Min. Screw	.10
18-33	75	2.5	.3	G-4½	Min. Screw	.10
18-34	76	3.6	.3	G-4½	Min. Screw	.10
18-35	77	2.5	.3	G-4½	Min. Screw	.10
18-36	78	3.6	.3	G-4½	Min. Screw	.10
18-37	79	2.5	.3	G-4½	Min. Screw	.10
18-38	80	3.6	.3	G-4½	Min. Screw	.10
18-39	81	2.5	.3	G-4½	Min. Screw	.10
18-40	82	3.6	.3	G-4½	Min. Screw	.10
18-41	83	2.5	.3	G-4½	Min. Screw	.10
18-42	84	3.6	.3	G-4½	Min. Screw	.10
18-43	85	2.5	.3	G-4½	Min. Screw	.10
18-44	86	3.6	.3	G-4½	Min. Screw	.10
18-45	87	2.5	.3	G-4½	Min. Screw	.10
18-46	88	3.6	.3	G-4½	Min. Screw	.10
18-47	89	2.5	.3	G-4½	Min. Screw	.10
18-48	90	3.6	.3	G-4½	Min. Screw	.10
18-49	91	2.5	.3	G-4½	Min. Screw	.10
18-50	92	3.6	.3	G-4½	Min. Screw	.10
18-51	93	2.5	.3	G-4½	Min. Screw	.10
18-52	94	3.6	.3	G-4½	Min. Screw	.10
18-53	95	2.5	.3	G-4½	Min. Screw	.10
18-54	96	3.6	.3	G-4½	Min. Screw	.10
18-55	97	2.5	.3	G-4½	Min. Screw	.10
18-56	98	3.6	.3	G-4½	Min. Screw	.10
18-57	99	2.5	.3	G-4½	Min. Screw	.10
18-58	100	3.6	.3	G-4½	Min. Screw	.10
18-59	101	2.5	.3	G-4½	Min. Screw	.10
18-60	102	3.6	.3	G-4½	Min. Screw	.10
18-61	103	2.5	.3	G-4½	Min. Screw	.10
18-62	104	3.6	.3	G-4½	Min. Screw	.10
18-63	105	2.5	.3	G-4½	Min. Screw	.10
18-64	106	3.6	.3	G-4½	Min. Screw	.10
18-65	107	2.5	.3	G-4½	Min. Screw	.10
18-66	108	3.6	.3	G-4½	Min. Screw	.10

PERMALLOY SHIELDS for CATHODE RAY TUBES
3" Shield $1.47
5" Shield 1.97

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1000 KC Crystal $2.97
Socket ..... .97

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

1B21	$2.87	3EP1	$2.87	305A	$12.95	843	$.39	C100D	$1.95	O1A	$.25
1B22	3.95	3E29	8.97	307A	3.95	845W	4.25	CK507AX	1.95	1A3	.57
1B23	8.95	3FP7	1.75	316A	.54	851	15.95	CK1005	.19	1A4	1.09
1B24	4.69	3GP1	6.75	327A	2.75	860	2.49	CK1006	.98	1A4P	.97
1B26	4.57	4-65A	14.49	338A	3.95	861	10.95	CK1090	2.95	1A5GT	.49
1B27	8.95	4-125A	27.45	350A	1.25	864	.49	EF50	.45	1A6	.79
1B29	3.49	4-250A	37.45	350B	1.89	865	2.95	F123A	12.95	1A7GT	.67
1B36	4.95	4AP10	5.95	353A	2.95	866A	1.05	F125A	14.95	1AB5	.69
1B38	47.50	4B24	3.95	353B	7.95	866JR	1.10	F127A	27.50	1B4	1.19
1D21	5.75	4C35	19.50	362A	1.95	869B	27.95	F128A	69.50	1B5/25S	.89
1N21	.95	4E27	12.75	368AS	3.95	872A	1.49	F606	22.50	1C5GT	.67
1N21B	1.65	4J32	97.50	371B	.85	874	.57	F660	125.00	1C6	.89
1N23	.79	5AP1	1.95	388A	2.95	876	.98	F862A	450.00	1C7G	.89
1N23B	1.95	5AP4	1.95	393A	3.85	878	1.98	FG17	2.89	1D5GP	.97
1N34	.85	5BP1	1.89	394A	3.85	884	1.39	FG27A	9.75	1D7G	.89
1P24	.79	5BP4	3.75	417A	14.50	885	1.39	FG81A	3.85	1D8GT	.95
1B21	3.95	5CP1	1.85	434A	3.50	902P1	3.85	FG95	17.95	1F4	.75
2AP1	3.89	5CP1A	9.95	446A	1.25	905	3.95	FG105	9.95	1F5G	.75
2C21	.27	5CP7	9.95	450TH	17.95	908	4.95	FG172	19.95	1G4GT	.69
2C22	.19	5C30	7.95	450TL	37.50	923	.97	FT210	13.95	1G6GT	.69
2C26	.69	5D21	27.95	527	9.95	930	.85	GL146	9.95	1H4G	.69
2C34	.27	5FP7	1.35	559	.85	931A	2.49	GL461	3.25	1H5GT	.84
2C40	6.39	5GP1	5.95	575A	12.95	953B	19.95	GL562	85.00	1H6GT	.87
2C43	8.95	5JP1	24.95	700A/B/C/D	34.50	954	.37	GL697	69.50	1J6GT	.89
2C44	.67	5JP2	11.75			955	.37	HY115	.85	1L4	.55
2C46	8.95	5J29	17.50	701A	3.60	956	.39	HY615	.79	1LA4	.79
2C51	8.25	5J30	49.50	702A	3.25	957	.24	HYE1148	.39	1LA6	.89
2D21	1.17	5LP1	13.95	703A	3.95	958A	.35	KC4	49.50	1LB4	.89
2E22	1.29	5NP1	2.89	705A	1.10	959	.37	KC610	9.75	1LC5	.79
2E24	4.87	6C21	19.69	706CY	18.75	991	.27	ML100	49.50	1LC6	.57
2E26	3.49	6F4	5.59	707B	14.95	1603	3.95	ML101	139.50	1LD5	.79
2J21A	10.95	6J4	5.95	708A	1.95	1611	.97	ML501	69.50	1LE3	.89
2J22	8.95	7BP7	6.65	713A	.95	1613	.59	ML502	149.50	1LG5	.89
2J26	7.95	9GP7	12.50	714A	12.95	1614	1.45	REL21	2.95	1LH4	.65
2J27	13.95	9JP1	6.95	714AY	3.95	1616	.98	REL36	.79	1LN5	.57
2J30	49.50	9LP7	2.25	715C	24.95	1619	.24	RK21	.79	1N5GT	.59
2J31	9.75	10BP4	24.95	717A	.59	1624	.98	RK23	4.85	1P5GT	.67
2J32	5.95	10Y	.49	721A	2.95	1625	.37	RK25	3.65	1Q5GT	.67
2J33	19.95	12DP7	14.95	723A/B	24.95	1626	.37	RK33	.27	1R4	.69
2J34	19.95	12GP7	13.95	724A/B	3.95	1629	.39	RK34	.27	1R5	.69
2J37	17.50	12HP7	13.95	725A	8.95	1630	3.95	RK59	1.95	1S4	.79
2J38	12.95	12AE	1.29	726A	14.95	1631	1.45	RK63	18.95	1S5	.57
2J39	34.50	15R	.79	730A	10.95	1632	.98	RK65	24.95	1T4	.57
2J40	49.50	23D4	.29	750TL	45.00	1633	.98	RK72	.97	1T5GT	.79
2J46	39.50	24G	.47	800	1.95	1636	6.75	RK73	.97	1U4	.69
2J48	39.50	30 Spec.	.35	801A	.49	1638	.79	RX21	3.19	1V	.69
2J49	24.95	45 Spec.	.29	802	4.25	1641	.69	RX120	8.95	2A3	.97
2J50	42.50	75TL	3.69	803	4.95	1642	.27	S836	2.95	2A4G	1.07
2J53	14.95	100R	2.95	804	4.95	1665	1.10	TZ40	2.95	2A5	.69
2J54B	39.50	100TH	11.50	805	4.95	1851	.97	V70D	6.95	2A6	.79
2J61	39.50	100TS	2.95	807	1.10	1960	2.95	VR65A	.98	2A7	.89
2J62	39.50	204A	57.50	808	1.39	2050	.75	VR75	.97	2V3G	.79
2K25	23.95	205B	1.75	809	2.75	2051	.43	VR78	.65	2X2	.89
2K26	14.95	211	.49	810	6.95	7193	.19	VR90	.67	2X2A	.69
2AP1	4.85	215A	.65	811	2.10	8005	4.75	VR105	.79	3A4	.57
3B22	2.69	217C	9.95	812	2.79	8011	.69	VR150	.55	3A5	.89
3B23	4.85	218	47.50	812H	6.99	8012	1.47	VT127	2.25	3B7	.35
3B24	1.59	221A	1.95	813	7.75	8013A	1.45	VU111	.59	3D6	.35
3B25	4.87	225	8.79	814	2.75	8014A	22.50	W146A	7.95	3G4	.59
3B26	1.79	227A	2.95	815	2.45	8016	1.25	WL530	17.50	3Q5GT	.67
3B27	3.85	231D	1.25	816	1.10	8020	3.25	WL531	7.95	3S4	.67
3BP1	2.95	249B	2.49	826	.42	8025	4.95	WL532	3.50	5H4GY	1.10
3C21	5.95	249C	2.89	829B	7.45	9001	.37	WL538	.69	5T4	.89
3C22	39.50	250R	7.45	830B	3.49	9002	.34	WL578	1.95	5U4G	.57
3C23	2.47	250TH	18.95	832A	4.25	9003	.37	WL616	87.50	5V4G	.89
3C24	.45	250TL	18.95	833A	32.50	9004	.37	WL619	19.95	5W4	.79
3C30	.49	274B	1.19	834	5.75	9005	1.95	WX3245	49.50	5X4G	.69
3C31	3.49	282B	9.75	836A	.99	9006	.24	OA2	1.57	5Y3GT	.57
3CP1	2.67	294A	4.57	837	.69	C5B	7.95	OA4G	.95	5Y4G	.49
3D21A	1.49	304TH	4.95	838	3.25	C6A	8.45	OB2	1.75	5Z3	.49
3DP1	1.97	304TL	1.39	841	.49	C6J	4.95	OZ4	.57	5Z4	.79
6A6	$.89	6U5	$.65	19	$.98
6A7	.69	6U7G	.55	24A	.67
6A8	.79	6V6	.97	25L6	.53
6AB7	.79	6V6GT	.69	25Z5	.69
6AC7	.77	6X4	.59	25Z6	.49
6AF6G	.79	6X5GT	.49	26	.57
6AG5	.77	6Y6G	.67	27	.47
6AG7	.98	6Z7G	1.15	28D7	.35
6AH6	1.29	6ZY5G	.69	30	.52
6AJ5	.79	7A4/XXL	.59	31	.89
6AK5	.85	7A6	.67	32	.97
6AK6	.79	7A7	.57	32L7GT	.97
6AL5	.65	7AG7	.72	33	.69
6AQ5	.59	7B4	.57	34	.69
6AQ6	.59	7B6	.59	35/51	.57
6AT6	.67	7B7	.59	35A5	.67
6AU6	.59	7C4	.37	35B5	.65
6AV6	.67	7C5	.57	35C5	.65
6BA6	.79	7C7	.59	35L6	.54
6BE6	.79	7E5	.67	35W4	.39
6BH6	.79	7E6	.59	35Y4	.49
6BQ6	.89	7E7	.69	35Z3	.57
6BR6	.89	7F7	.69	35Z4	.44
6BS6	.89	7F8	.64	35Z5	.39
6BT6	.89	7H7	.64	36	.57
6BU6	.89	7L7	.69	37	.58
6BQ6G	1.47	7N7	.67	38	.29
6BH6	.87	7Q7	.59	39/44	.27
6BJ6	.89	7R7	.89	41	.52
6C4	.25	7W7	.89	42	.49
6C5	.47	7X7	.89	43	.49
6C6	.57	7Y4	.57	45	.52
6C8G	.69	7Z4	.57	45Z3	.57
6D6	.47	12A	.57	45Z5	.49
6D8G	.87	12A6	.19	46	.69
6E5	.87	12A7	.98	47	.69
6F5	.47	12A8GT	.59	50A5	.49
6F6	.65	12AH7GT	.85	50B5	.55
6F7	.85	12AT6	.45	50L6	.52
6F8G	.87	12AU6	.47	50Y6	.57
6G6G	.89	12AU7	.79	53	.87
6H6	.47	12BA6	.57	56	.45
6J5	.79	12BE6	.59	57	.38
6J6	.77	12C8	.49	58	.49
6J7	.67	12F5GT	.58	59	.89
6J7GT	.45	12H6	.27	70L7	1.17
6K7	.49	12J5	.27	71A	.67
6K8	.79	12K7	.54	75	.53
6L5	.89	12K8	.59	76	.39
6L6	1.17	12Q7	.57	77	.43
6L6GA	.87	12SA7	.57	78	.45
6L7	.79	12SC7	.57	80	.39
6N7	.79	12SF7	.57	81	1.29
6Q7	.59	12SG7	.57	82	.87
6R7	.79	12SH7	.35	83	.72
6S7	.79	12SJ7	.47	83V	.89
6SA7	.44	12SK7	.57	84/6Z4	.63
6SC7	.59	12SL7	.59	85	.49
6SD7GT	.69	12SN7	.52	89Y	.39
6SF5	.49	12SQ7	.59	117L7/M7	1.29
6SF7	.59	12SR7	.49	117N7	1.37
6SG7	.59	12Z3	.79	117P7	1.27
6SH7	.49	14A4	.79	117Z3	.57
6SJ7	.57	14A7	.69	117Z6	.65
6SK7GT	.55	14B6	.67		
6SL7GT	.65	14F7	.69		
6SN8GT	.79	14F8	.65		
6SN7GT	.65	14H7	.65		
6SQ7	.57	14N7	.89		
6SR7GT	.57	14Q7	.67		
6S87	.59	14R7	.67		
6T7G	.98	15	.89		

OIL CONDENSERS
All Ratings D. C.

.25 mfd.	600v	$ .37	1 mfd.	2000v	$1.07
.5 mfd.	600v	.37	2 mfd.	2000v	1.47
1 mfd.	600v	.37	4 mfd.	2000v	3.77
2 mfd.	600v	.37	8 mfd.	2000v	4.95
2x2 mfd.	600v	.77	15 mfd.	2000v	4.95
4 mfd.	600v	.57	1 mfd.	2500v	1.45
6 mfd.	600v	.97	25 mfd.	2500v	1.77
8 mfd.	600v	1.07	5 mfd.	2500v	1.98
10 mfd.	600v	1.27	.05 mfd.	3000v	1.75
.25 mfd.	1000v	.47	.25 mfd.	3000v	2.65
.5 mfd.	1000v	.57	.5 mfd.	3000v	2.75
1 mfd.	1000v	.67	1 mfd.	3000v	2.98
2 mfd.	1000v	.77	2 mfd.	3000v	3.47
4 mfd.	1000v	1.37	4 mfd.	3000v	4.45
8 mfd.	1000v	1.97	12 mfd.	3000v	6.97
10 mfd.	1000v	2.07	1 mfd.	4000v	4.25
15 mfd.	1000v	2.42	2 mfd.	4000v	4.85
20 mfd.	1000v	3.27	3 mfd.	4000v	5.45
.5 mfd.	1500v	.77	1 mfd.	5000v	4.98
1 mfd.	1500v	.97	4 mfd.	5000v	5.45
2 mfd.	1500v	1.17	.1 mfd.	7000v	2.97
4 mfd.	1500v	1.77	.1 mfd.	7500v	2.97
24 mfd.	1500v	5.47	.01 mfd.	7500v	2.45
.1 mfd.	2000v	1.07	.02 mfd.	7500v	2.75
.25 mfd.	2000v	1.17	.05 mfd.	7500v	2.97
.5 mfd.	2000v	1.27	.02 mfd.	7500v	6.95
				12000v	9.97

HI CAPACITY CONDENSERS
All Ratings D. C.

2x3500 mfd	25v	$3.47	200 mfd	35v	$ .57
2500 mfd	5v	.35	100 mfd	50v	.45
3000 mfd	25v	2.45	4000 mfd	18v	1.95
2x1250 mfd	10v	1.27	2350 mfd	24v	2.25
1000 mfd	15v	.98	10000 mfd	25v	4.57

TRANSFORMERS—115 V. 60 Cy.
HI-VOLTAGE INSULATION

6350v @ .025 amps	$12.95
2200v @ 4 ma; 6.3v @ 1A; 2½v @ 2A	5.97
2500v @ 15 ma	$4.29
1700v @ 4 ma; 6.3v @ 1A; 2½v @ 2A	4.98
1600v @ 4 ma; 700v CT @ 150 ma; 6.3v @ 9A	4.97
1500v @ 7 am; 2.5v @ 3A	4.47
525-0-525v @ 60 ma; 925v @ 10 ma, 2x5v @ 3A; 6.3v @ 3.6A; 6.3v @ 2A; 6.3v @ 1A	6.97
500-0500v @ 175 ma	4.95
500-0-500v @ 25 ma; 262-0-262v @ 55 ma; 6.3v @ 1A; 2x5v @ 2A	4.45
425-0-425v @ 75 ma; 5v @ 2A; 6.3v @ 1.5A	3.98
400-315-0-100-315v @ 200 ma; 2.5v @ 2A; 5v @ 3A; 2x6.3v @ 9A	5.95
385-0-385-550v @ 200 ma; 2.5v @ 2A; 5v @ 3A; 2x6.5v @ 6A—prl 110-220	6.27
287-0-287v @ 70 ma; 5v @ 10A; 5v @ 8A; 5v @ 3A	4.95
340-0-340v @ 300 ma; 1540v @ 5 ma	4.95
600v CT @ 100 ma; 5v @ 2A; 12½v @ 2A; 12½v @ 3A	3.37
200-0-200v @ 65 ma; 2x5v @ 2A; 6.3v @ 2½A; 6.3v @ 1A	3.47
275-0-275v @ 240 ma; 325-0-325v @ 12 ma	4.98
120-0-120v @ 50 ma	.97
80-0-80v @ 225 ma; 5v @ 2A; 5v @ 1A	3.49
56v @ 15A	$ 9.95
18v @ 15A	8.95
12.6v CT @ 10A; 11v CT @ 6.5A	6.95
12v CT @ 10A; 2x5v CT @ 10A	7.49
2x10.5v CT @ 7A	6.95
8v CT @ 1A	.97
6.3v @ 21½A; 6.3v @ 2A; 2½v @ 2A	4.45
6.3v @ 12A; 6.3v @ 2A; 115v @ .1 amps	3.45
6.3v @ 10A; 6.3v @ 2A	2.47
6.3v CT @ 3.5A; 2x2.5v @ 3A	2.97
6.5v @ 8A; 6.5v @ 5A; 5v @ 3A; 2.5v @ 1.75A	4.45
6.3v @ 1A; 2.5v @ 2A	$2.25
5v @ 20A; 10KV ins	9.97
5v @ 3A; 2.5v @ 2A	2.97
6.3v @ 800 ma	$14.97
10 hy @ 250 ma	2.47
12 hy @ 200 ma	1.90
20/20 hy @ 85 ma	1.57
30 hy @ 125 ma	1.47
15 hy @ 100 ma	1.37
5 hy @ 50 ma	.27
30 hy dual @ 20 ma	1.47
3/30 hy @ 250 ma	3.47
2 hy @ 175 ma	1.49
14 hy @ 40 ma	6.75
60 hy @ 50 ma	6.97

SELENIUM RECTIFIERS
Full Wave Bridge Type

INPUT	OUTPUT		
up to 18v AC	up to 12v DC	½ Amp.	$1.47
up to 18v AC	up to 12v DC	1 Amp.	1.97
up to 18v AC	up to 12v DC	5 Amp.	5.27
up to 18v AC	up to 12v DC	10 Amp.	8.97
up to 18v AC	up to 12v DC	15 Amp.	11.57
up to 18v AC	up to 12v DC	30 Amp.	22.57
up to 36v AC	up to 28v DC	1 Amp.	3.47
up to 36v AC	up to 28v DC	5 Amp.	8.57
up to 36v AC	up to 28v DC	10 Amp.	14.57
up to 36v AC	up to 28v DC	15 Amp.	22.27
up to 115v AC	up to 100v DC	.25 Amp.	2.57
up to 115v AC	up to 100v DC	.6 Amp.	5.27
up to 115v AC	up to 100v DC	5 Amp.	22.57
up to 115v AC	up to 100v DC	3 Amp.	17.97

FILTER CHOKES
HI-VOLTAGE INSULATION

10 hy @ 400 ma	$ 5.97	1 hy @ 800 ma	$14.97
15 hy @ 70 ma	1.17	10 hy @ 250 ma	2.47
12 hy @ 150 ma	1.47	10 hy @ 200 ma	1.90
30 hy @ 60 ma	1.37	10/20 hy @ 85 ma	1.57
.05 hy @ 15 amps	7.97	15 hy @ 125 ma	1.47
.1 hy @ 5 amps	6.97	15 hy @ 100 ma	1.37
4 hy @ 600 ma	5.97	5 hy @ 50 ma	.27
200 hy @ 10 ma	3.47	30 hy dual @ 20 ma	1.47
600 hy @ 1 ma	3.17	3/30 hy @ 250 ma	3.47
325 hy @ 3 ma	3.47	2 hy @ 175 ma	1.49
3.5 hy @ 400 ma	6.75	14 hy @ 40 ma	6.75
6 hy @ 400 ma	6.97	60 hy @ 50 ma	6.97

PHONE DIGBY 9-0347

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE
All Merchandise Guaranteed
F.O.B. New York City. Minimum Order $5.00
20% Deposit Required

Finest of Surplus PEAK ELECTRONICS CO. Fraction of Cost

FEDERAL ANTI-CAPACITY SWITCH. Double Pole. Double Throw .....85¢ each; 10 for $7.50

W. W. POWER RHEOSTAT

25 Ohms 25 Watt ..... .49
150 Ohms 50 Watt ..... .59
250 Ohms 50 Watt ..... .59
300 Ohms 50 Watt ..... .59
Dual 200 Ohms 50 Watt ..... .79
8 Ohms 150 Watts 1.79

WESTERN ELECTRIC MOTOR

65 RPM. 110 Volts 60 cy 11 Watts. Torque 75 oz inch, 3" diameter 3½ Long. Complete with Capacitor 3.95

OIL CONDENSERS

20	mfd	330 vac	1.85	2	mfd	4000 vdc	4.95
5	mfd	150 vac	.49	1	mfd	5000 vdc	4.50
1	mfd	600 vdc	.29	1/.1	mfd	7000 vdc	2.25
2	mfd	600 vdc	.39	.1	mfd	7500 vdc	1.95
4	mfd	600 vdc	.59	1	mfd	7500 vdc	9.25
6	mfd	600 vdc	.79	.01/.01	mfd	12 kv dc	5.75
3/3	mfd	600 vdc	.79				
10	mfd	600 vdc	.89	.005/.01	mfd	12 kv dc	5.50
4	mfd	1000 vdc	.95				
15	mfd	1000 vdc	2.95	65 mfd	12,500 vdc		12.95
2	mfd	1500 vdc	1.25				
6	mfd	1500 vdc	2.95	.75/.35	mfd	8/16 kv dc	7.95
1	mfd	2000 vdc	1.45	.2	mfd	18 kv dc	59.50
2	mfd	2000 vdc	2.25	Mfd	15	kv dc	15.95

HIGH VOLTAGE—CURRENT MICAS

MMF	VDC	Price	MMF	VDC	Price
D .001	600	$ .18	C .006	3 KV	$1.50
E .01	600	.20	D .002	3 KV	.70
E .02	600	.26	C .0001	5 KV	.70
E .027	600	.26	C .0005	5 KV	.85
D .039	600	.30	C .0015	5 KV	1.60
C .01	1 KV	.45	C .003	5 KV	1.90
C .056	1 KV	.50	C .005	5 KV	2.50
C .07	1 KV	.55	B .007	5 KV	2.75
D .02	1200	.35	B .002	6 KV	3.50
C .024	1500	.65	B .003	6 KV	3.75
C .033	1500	.75	A .004	6 KV	4.95
C .015	2 KV	.80	B .006	6 KV	4.25
C .02	2 KV	.90	B .0005	8 KV	2.90
D .002	2500	.45	B .001	8 KV	3.25
E .005	2500	.55	B .002	8 KV	4.00
C .025	2500	1.25	B .003	8 KV	4.75
C .001	3 KV	.90	B .004	8 KV	5.50
C .002	3 KV	.95	A .0099	15 KV	32.50
D .005	3 KV	.70	A .0059	18 KV	28.50
C .005	3 KV	1.24	A .0013	30 KV	36.50
			A .0013	15 KV	22.50

A .08 4KVDC 35 Amps at 300 KC 32.50
A .037 6KVDC 45 Amps at 1000 KC 32.50

CHOKE BARGAINS

6 Henry 50 ma 300 ohms ..... 3 for $0.99
6 Henry 80 ma 220 ohms ..... 2 for .99
8 Henry 160 ma 140 ohms ..... .99
1.5 Henry 250 ma 72 ohms ..... .59
6 Henry 300 ma 65 ohms 3.75
4.3 Henry 620 ma 42 ohms 6.95
Swing. Choke 1.6/12 Henry 1 Amp/100 ma 15 ohm 17.95

UTC type PA 5000 ohm plate to 500 ohm line and 6 ohm voice coil. 10 watts. 60 to 10,000 cps +1 DB. GREAT VALUE ..... ea. $2.75

Thermal Time Delay Relay. 15 to 30 seconds, plugs into 4 Prong Tube Socket Glass Enclosed. 250 V. .95 ea.

Mallory Vibrosack Kit. 6 Volt Input. Output 300 Volts at 100 MA. Transformer & Vibrator ..... 5.95 for both

U. H. F. COAX. CONNECTORS

83IAP-UGI2U—UG2IU-UG-14U-83I R-83ISP .35 ea.

Precision 15 Meg. 1% Accuracy Resistor, Non-inductive, 1 watt, hermetically sealed in glass. 29 ea. 10 for $2.50

50 megohm 35 watt Resistor with mount . $1.95 each; 10 for $15.00

PANEL METERS—BRAND NEW

2" WESTON .0-1 Ma DC 26 ohms res $3.50
2" GE 0-1 Ma DC (volt scale) 2.95
2" GE 0-5 Ma DC (amp scale) 1.95
2" WESTINGHOUSE 0-10 Ma DC 2.45
2" GE 0-30 Volts DC 1000 ohm/v 2.50
2" WESTON 0-250 Volts DC 2.50
2" WESTON 150-0-150 Micoamps DC 3.49
2" GE 0-30 Amps DC 2.45
2" GE 0-1 Amp RF (Internal Thermo) 2.45
2" WESTON 0-1 Amps RF (Internal Thermo) .. 2.00
3" WESTINGHOUSE 0-2 Ma DC 3.95
3" WESTERN ELECTRIC 0-80 Ma DC 2.95
3" DEJUR 0-100 Ma DC 2.95
1" GE 0-200 Ma DC 3.95
3" WESTON 0-50 Amps AC 4.95
3" TRIPLETT 75 Amps AC 2.95
3" WESTINGHOUSE 0-20 Ma DC 3.95

ADVANCE D. P. D. T. ANTENNA RELAY

110 V. 60 cycle coil Steatite insulation. Only $1.95 each.

GENERAL PURPOSE TRANSFORMERS

Ideal for Bias, Filament, Isolation, Stepdown, etc. 2 isolated 110v pr. sec. 110v at 900 ma plus 6.3 @ 2 amps. Fully cased ..... New $1.49 ea.

FILAMENT TRANSFORMERS

110V 60Cy Pri. Fully Cased.
5 Volt 15 Amp $2.75
2.5 Volt 10 Amp 3.49
2.5 Volt CT 21 Amp 4.75
6.3 Volt 10 Amp 1.89

MULTIPLE SECONDARIES

5¹₄V CT 21A, 7.5V 6A, 7.5V 6A $4.95
5 Volt 4A, 6.3V, 3A 2.45
2.5V CT 20A, 2.5V CT 20A 6.95
2.5V CT 10A, 10V 3A, 5V 3A, 5V 3A 3.95

MEGOHM METER

Industrial Instruments model L2AU 110/220 volts 60 cycle input. Direct reading from 0-100000 megohms on 4" meter can be extended to 500000 megohms with external supply. Sloping hardwood Cabinet 15"x8"x 16". Brand new with tubes plus running spare parts including extra tubes. Great value. Only $69.50.

PLATE AND FIL. TRANSF. PRI 110 v 60 cy. sec. 1120 volts CT @ 600 ma. 6.3v CT @ 3A, 2x5VCT @ 6A Hermetically sealed ..... $9.95 ea.

1500, 5000 Ohm 100 Watt Ferrule Resistors.
20,000 Ohm 50 Watt Ferrule Resistors.
Any Types only .08 ea. Min. Order $5.00.

HS 30 HEADPHONES

250 ohms imp. Can be used for sound Power Telephones.
Brand new ..... .89 ea.

LARGE QUANTITY AVAILABLE AT REDUCED PRICES

PHASE SHIFT CAPACITOR

4 Stator Single Rotor. 0-360 Degrees Rotation ..... Only $2.95 each

PLUG IN CAPACITOR

8 x 8 Mfd 600 volts DC. Oil filled. Plugs into standard 4 prong socket. 3¾ h x 3¼ w x 1⅞ d $1.39

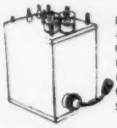
SELSYN MOTORS

115 volts 60 cycles. Large size high torque. Made by Diehl and Bendix. Ideal for rotating TV beam, etc. Great value at 5.95 per pair.

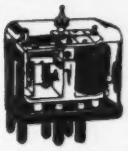
SCOPE TRANSFORMERS

Pri 110V 60 Cy — Hermetically Sealed
2500V @ 12 Ma. $3.95
2300 @ 4 MA, 2.5 Volts @ 2 Amps 4.95
1050V ⅛ 20Ma. 20V 4.5A. 2.5V 5A 4.75

SCOPE AND FIL. TRANSFORMER



Pri. 115 volts, 60 cycles. Sec. 4400 volts RMS 4.5 MA., 5 volts CT 3 amps., Fil. Ins. 15 KV RMS test. Hermetically sealed. Has insulated plate cap for rectifier. Made by Raytheon. 4½ x 5 x 5½ ..... Only $6.75



WESTINGHOUSE

Type MN Overcurrent Relay, Adjustable from 250 ma. to 1 amp. External Push Button Reset. Enclosed in glass case. Hand calibrated adjustments, only $5.95.

WIRE WOUND RESISTORS

5 Watt type AA, 20-25-50-200-470-2500-4000 ohms ..... $ .09 ea.
10 Watt type AB, 25-40-84-100-470-1325-1000-2000-4000 ohms ..... .15 ea.
20 Watt type DG, 50-70-100-150-300-750-1000-1500-2500-2700-5000-7500 10000-16000-20000-30000 ohms ..... .20 ea.

30 WATT WIRE WOUND RESISTORS

Ohms: 100-150-1500-2500-3k-4k-4500-5k-5300-10k 15k-18k ..... 15 ea. 8 for .99

ADJUSTABLE RESISTORS

20 Watt: 1, 5, 50 Ohms ..... .25
50 Watt: 80, 100 500 Ohms ..... .35
75 Watt: 40, 80, 100, 150, 200 Ohms ..... .39
100 Watt: 20, 50, 75, 120, 180 Ohms ..... .49
150 Watt: 50, 100 Ohms ..... .59

1% PRECISION RESISTORS

2000-2500-5000-8500-10,000 ohms ..... ea. .25
50000-95000 ohms ..... ea. .29
10000-750000-1 meg ..... ea. .69

THORDARSON POWER TRANSFORMER

700 Volts CT. at 145 MA. 6.3V at 4.5 Amp., 5 Volts at 3 Amp. Pri 110 Volts 60 Cycles. Fully Shielded ..... $2.99 each

DUNCO RELAY. 6 Volt 60 Cycle AC Coil Dpst. Ceramic Insulation 1.95

HIGH CURRENT PLATE TRANSFORMER

820 Volts CT at 775 MA. Pri 110/220 Volts 60 Cycles. Wt. 36 lbs. Fully Cased 6.95

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.001 1000 VDC Micas ..... 9 for .99
.01 600 VDC Mica Cond ..... 9 for .99
.02 400 V DC Tubulars ..... 15 for .99
.05 600 VDC Oil Tubular ..... 10 for .99
10 MMF Midget Variable Cond ..... 4 for .99
Heinman 5 Amp 110 VAC CKT Breaker ..... .99
Heinman 25 Amp 110 VAC CKT Breaker 1.49
2 MFD 250 VAC Oil Cond ..... 5 for .99
Solar .02 600 VDC Dominoes ..... 9 for .99
Erie .0005 N750D Ceramicons ..... 15 for .99
1x.1/2 KV DC Oil-Condenser ..... .79
H&H SPST P.B. Switch N.O. ..... 5 for .99
1/40 Amp (25 Ma) Littlefuses ..... 15 for .99
.25 MFD 600 V. Tubulars ..... 6 for .99
Butterfly Cond. 2-11 MMF Ball Bearings ..... 2 for .99
.0015 5% Silver Micas ..... 9 for .99
Midget Closed CKT Jacks ..... 7 for .99
CD Type 4 .001 600 VDC Micas ..... 50 for 4.99

PEAK ELECTRONICS CO.

Phone CO 7—6486 —6443

188 Washington St., New York 7, N. Y. *DEPARTMENT EA*

SELENIUM RECTIFIERS
— and —
ELECTRONIC COMPONENTS

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-126VAC Type #	Current	Output 0-136*VDC Price
3B7-4	4 AMP.	$32.95
3B7-6	6 AMP.	48.90
3B7-15	15 AMP.	70.00

Input 0-234VAC Type #	Current	Output 0-250*VDC Price
3B13-4	4 AMP.	$36.90
3B13-6	6 AMP.	51.50
3B13-15	15 AMP.	120.00

SINGLE PHASE FULL WAVE CENTER TAPPED RECTIFIERS

Input 10-0-10VAC Type #	Current	Output 9-8*VDC Price
C1-10	10 AMP.	$6.95
C1-20	20 AMP.	10.95
C1-30	30 AMP.	14.95
C1-40	40 AMP.	17.95
C1-50	50 AMP.	20.95
C1-80	80 AMP.	28.95
C1-120	120 AMP.	38.95

CUSTOM DC POWER SUPPLIES
Built to your specifications.
For:
- INDUSTRY
- LABORATORIES
- UNIVERSITIES
- GOVERNMENT AGENCIES

We will be pleased to quote on your requirements.

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-18VAC Type #	Current	Output 0-12*VDC Price
B1-250	250 MA.	$ .95
B1-500	500 MA.	1.95
B1-1	1 AMP.	2.49
B1-3X5	3.5 AMP.	4.50
B1-5	5 AMP.	5.95
B1-10	10 AMP.	9.95
B1-15	15 AMP.	13.95
B1-20	20 AMP.	15.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95
B1-60	60 AMP.	36.95
B1-80	80 AMP.	44.95
Input 0-36VAC Type #	Current	Output 0-26*VDC Price
B2-150	150 MA.	$.98
B2-250	250 MA.	1.25
B2-300	300 MA.	1.50
B2-450	450 MA.	1.95
B2-1	1 AMP.	3.95
B2-2	2 AMP.	4.95
B2-3x5	3.5 AMP.	6.95
B2-5	5 AMP.	9.95
B2-10	10 AMP.	15.95
B2-15	15 AMP.	24.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95
B2-40	40 AMP.	44.95
Input 0-54VAC Type #	Current	Output 0-38*VDC Price
B3-150	150 MA.	$1.25
B3-250	250 MA.	1.95
B3-600	600 MA.	3.25
B3-5	5 AMP.	13.95
B3-10	10 AMP.	24.95
Input 0-72VAC Type #	Current	Output 0-50*VDC Price
B4-600	600 MA.	$3.95
B4-3	3 AMP.	14.95
B4-5	5 AMP.	17.95
B4-10	10 AMP.	27.95
Input 0-115VAC Type #	Current	Output 0-90*VDC Price
B6-150	150 MA.	$1.95
B6-250	250 MA.	2.95
B6-600	600 MA.	5.95
B6-750	750 MA.	6.95
B6-1X5	1.5 AMP.	10.95
B6-3X5	3.5 AMP.	18.95
B6-5	5 AMP.	24.95
B6-10	10 AMP.	36.95
B6-15	15 AMP.	54.95
Input 0-234VAC Type #	Current	Output 0-190*VDC Price
B13-600	600 MA.	$12.95
B13-1X5	1.5 AMP.	19.95
B13-3	3 AMP.	35.95
B13-5	5 AMP.	48.95
B13-10	10 AMP.	69.95

Select Proper Capacitor to Obtain Higher VDC Than Indicated.

RECTIFIER CAPACITORS

CF-14	3000 MFD	12VDC 1.69
CF-15	6000 MFD	12VDC 2.95
CF-1	1000 MFD	15VDC .98
CF-2	2000 MFD	15VDC 1.69
CF-20	2500 MFD	15VDC 1.95
CF-3	1000 MFD	25VDC 1.25
CF-4	2X3500 MFD	25VDC 3.45
CF-5	1500 MFD	30VDC 2.49
CF-6	4000 MFD	30VDC 3.25
CF-7	3000 MFD	35VDC 3.25
CF-8	100 MFD	50VDC .98
CF-19	500 MFD	50VDC 1.95
CF-16	2000 MFD	50VDC 3.25
CF-21	1200 MFD	90VDC 3.25
CF-9	200 MFD	150VDC 1.69
CF-10	500 MFD	200VDC 3.25
CF-12	125 MFD	350VDC 2.49

RECTIFIER TRANSFORMERS
All Primaries 115VAC 50/60 Cycles

Type #	Volts	Amps.	Price
XF15-12	15	12	$3.95
TXF36-2	36	2	3.95
TXF36-5	36	5	4.95
TXF36-10	36	10	7.95
TXF36-15	36	15	11.95
TXF36-20	36	20	17.95
XFC18-14	18 VCT	14	5.95

All TXF Types are Tapped to Deliver 32, 34, 36 Volts. XFC type is tapped to deliver 16, 17, 18 Volts Center-Tapped.

RECTIFIER CHOKES

Type		Amps.	Price
HY5	.02 Hy	5	$3.25
HY8X5	.02 Hy	8.5	7.95
HY10	.02 Hy	10	9.95
HY12	.02 Hy	12	12.95
HY15	.015 Hy	15	13.95

RECTIFIER SURGE PROTECTION

When an inductive DC circuit is opened, a high voltage surge is produced that may damage a rectifier power supply. This danger can be reduced by the application of a non-linear resistance device known as Thyrite. Further information will be found in catalog #719.

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... $ .35 per set
For Types B13 ..... .70 per set
For Types 3B ..... 1.05 per set

RECTIFIER KIT #612-10
6 and 12 VDC at 10 Amps.

This unit will deliver unfiltered direct current for operation of motors, dynamotors, solenoids, electroplating, battery charging and similar equipment. The two output voltages may be used simultaneously, and varied above and below their nominal ranges.
Complete with schematic diagram; shpg. wt., 12 lbs. **$15.95**

Filter Kits For #612-10

1 Section choke input, 10% ripple..$ 9.64
2 Section choke input, 2% ripple....19.28

PILOT LIGHT ASSEMBLIES

Aircraft type, panel mounting, amber jewel. Knurled rim, controls "Dim-Bright". Bakelite and aluminum construction. Bulb replaceable from front panel. For single contact bayonet bulbs, up to T-3¼ size. Dimensions: 2¼" overall length, 3⅛" diameter, ⅝" panel mtg. hole.
IMMEDIATE DELIVERY — 500 to Carton. Request Sample and Price on company letterhead.

WRITE FOR SELENIUM RECTIFIER CATALOG #719

VACUUM CAPACITORS

Standard Brands

12 Mmfd	20 Kv.	$4.95
50 Mmfd	20 Kv.	4.95
50 Mmfd	32 Kv.	5.95

OIL CONDENSERS

2 Mfd 200VDC Bathtub..... $ .20
5 Mfd 400VDC telephone type..... .20
2 Mfd 400VDC Bathtub..... .30
2X.1 Mfd 600VDC Bathtub..... .39
6 Mfd 600VDC w/mtg. Clamp..... .79
8 Mfd 660VAC/2000VDC w/Brkts.. 3.50
15-.15 Mfd 8000VDC Voltage Doubler Type 26F381 w/Brkts..... 3.95

SPECIAL—LIMITED QUANTITY FAMOUS BRAND VITAMIN Q PHOTOFLASH CAPACITORS

6 Mfd-3000 V.D.C.—36 Watt Sec. 4¼"x 1⅝"x1¾". Wt. 1-lb 12-oz. Price, each $5.95

3 for $15.00

ATTENTION!!!

Bulletin #713, listing various government and commercial surplus items, is now available upon request.

VOLTAGE REGULATORS

These solenoid operated carbon pile regulators will stabilize the output of 12-18 VDC power supplies, simply by connecting the coil leads across the output of the rectifier, and the carbon element leads in series with the load.
Price each $2.49

D-C POWER SUPPLY FTR 3377-AS

Rating 115 VAC to 115 VDC, .77 Amperes. Operates fans, motors, magnetic chucks, business machines, relays, etc. Descriptive literature available.
Brand new, ready to operate..... $16.50

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane solenoid type with accuracy within 5%.

0-6 Amperes D-C	Any range
0-12 Amperes D-C	$2.49 each
0-15 Volts D-C	

Minimum order $3.00. No C.O.D.'s under $25.00. 25% deposit on C.O.D. Add 10% for Prepaid Parcel Post and Handling. Terms: Net 10 days in the presence of approved credit.

All prices subject to change without notice.
Orders Promptly Filled from Our Stocks
All Prices F.O.B. our NYC Warehouse

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Phone: BEekman 3-7385-6

LINEAR SAWTOOTH POTENTIOMETER
No. KS 15138

Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. Size approximately 3⅝" dia. x 3" deep x 4¾" long. Enclosed in die cast alum. frame with AN connector socket.

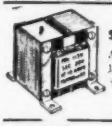
$5.75
Brand New

FULL WAVE BRIDGE TYPE SELENIUM RECTIFIER

Input up to 36V A.C.
Output up to 28V D.C. at 1.1 amps.

8 plates 2⅛" diameter
Fed. Tel. & Tel. Co.

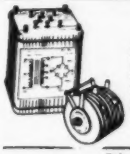
Brand New **$2.75**



20 Volts at 10 Amps. STEPDOWN TRANSFORMER

Also tapped at 6V.
115 Volt input. Ideal for Selenium Rectifier Applications.

Brand New **$2.45**



12 and 24 Volt POWER KIT

Consists of Power Trans. and full wave bridge selenium rectifier. Input: 115/230 A.C. Output: 12/24V D.C. at 1.1 amps. Fine for operating relays, small motors dynamotors, or for low voltage D.C. source in laboratories, etc.

Brand New **$7.95**

Filament Transformers
For type 866 tubes

Input: 115 volts. Output: 2.5 volts center tapped, at 10 amps. Glazed porcelain standoff insulated for high voltage breakdown. Mfgd. by Kenyon.

Brand New **$3.95**

Micro-Wave Lavoie Freq. Meter
375 to 725 MCS

Model TS-127/U is a compact, self contained, battery powered, precision (± 1 MC) frequency meter which provides quick, accurate readings. Requires a standard 1.5V "A" and 45V "B" battery. Has 0-5 MIN. time switch. Contains sturdily constructed HI-"Q" resonator with average "Q" of 3000 working directly into detector tube. Uses 957, L36 and 2S4 Tubes. Complete, new with inst. book, probe and spare kit of tubes. Less batteries

Full data on request. **$69.50**

MP22 Mast Base Insulator

Ideal for marine, mobile vertical whip antenna. Complete, new with mounting plate and hardware..... $2.75

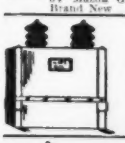
3CM Antenna Horn For receiving or transmitting Type AT-48/UP with coax receptl. Brand new $4.75

LINE FILTER

Elimostat 20 amp. 115 volts A.C. or 600 D.C. Brand new $1.75

PILOT LAMP

Aircraft "grain of wheat" 3V Mazda G.E. 323. Brand New .....10¢ ea.



HIGH VOLTAGE CAPACITORS

.5 MFD—25,000 Volts Ineteen filled, New.....$23.50
Shpg. Wt. 35 lbs.

1 MFD—15,000 Volts Pyranol filled, New $16.50
Shpg. Wt. 35 lbs.

1 MFD—7500 Volts Ineteen filled, New $6.75

SWITCHBOARD LAMP

RECEPTACLE AND JEWEL...Brand New.. .25
24 volt lamps for above.....$12.50 per C.

RADIO MODULATOR

Type BC-423-B, or tweeter, is a miniature keying unit, modulator and transmitter combined. A dipole mounted atop the tweeter case radiates a signal pulse at 205 megacycles modulated by pulses occurring at 4,098 CPS. Uses 2-6J7, 1-6F6, 1-955, 1-5W4 tubes. Operates from 115V, 60 cy. source. Brand new including tubes and instruction book....$59.50

SHOCK MOUNTINGS

A B C D E

Lord #20, 3" x 3" x 1¾.....30
U. S. Rubber #5150 C, 2¾" x 2¾" x 1⅛".....20
Lord 15, 2¾" x 2¾" x 1⅛".....20
Lord #3, 1¼" x 1¼" x ⅜".....10
Lord # 10, 1¼" x 1¼" x ⅜".....10

LINE VOLTAGE STABILIZERS

Raytheon—Navy Type, CRP-30107 Input: 92-138V, 57/63 CPS., 1 PH. Output: 115V., 0.82 KVA., 1% Reg., 0.96 PF. Weight 250 lbs. Enclosed in Navy Grey Ventilated Cabinet for Wall Mounting.
Brand New $97.50
Raytheon—Spec. No. W 5768 Input: 95-130V., 1.25A., 60 CPS., 1 PH. Output: 115V., 60 watts., Load P.F. 90%.
Brand New $12.50
SOLA—Cat. No. 3004, 115V., 60 cy., 1 PH. 500 V.A. $32.50

THERMOSTATIC TIME DELAY RELAY

Amperite type 115 No.—45 Heater voltage 115V. Normally open SPST contacts, 45 sec. delay. Contact rating 115V-3A., A. C. (or 440V., A.C. 2A) max. voltage on contacts—1000. max voltage bet. contacts and heater—1500. Size 3 9/32 x 1¼" overall. Made for U. S. Navy $1.10

AUTO TRANSFORMER

G.E. 400 cy. Cat. No. 80G184 K.V.A. .9458—520P Volts 460/345/230/115 New $4.50

FILAMENT TRANS.
400/2600 cy.

Input: 0/75/80-85/105/115/125V Output: 5V3A, 5V3A, 5V3A, 5V3A, 5V6A, 5V6A, 6.3V5A, 6.3V5A $3.95

THYRATRON POWER TRANS.

Raytheon UX5876, 400/1600 cy. PRI: 115V, 1 PH Sec: 50-0-50V at 0.5A, 6.3V 1.2A Test RMS1780 $2.75

Pulse, Input Trigger Inverting

Westinghouse 145 R.N. Fosterised.....$2.85

PULSE

Utah No. 9350.....$1.25

BLOCKING, OSC.

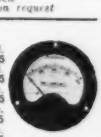
Westinghouse #132 Fosterized S/N 132 .....$2.95

U. S. NAVY SYNCHROS

Types 5F, 5DG, 5SF, 5SDG, 6DG
Also various synchro line-factor capacitors in stock
Prices on request

METERS

Westhse NX35-0-800MA.—2" Rd. Bkite. $3.85
Westhse NT35-0-5A. R.F.—3" Rd. Bkite. $4.75
Triplett 227A-0-150MA —2" Sq. Bkite. $2.65
G.E. DO-41-0-1MA. 3" Sq. Bkite. $4.25
G.E. DO-33-0-1MA. 3" Sq. Bkite. $4.25
JET 30FX.-380-420 cy. 3" Sq. Bkite. $5.75
Write for meter list



0-800 MA

MERCURY CONTACT VACUUM RELAYS
WE Type D-168479

Glass sealed, mercury-wetted contact switches surrounded by operating coils encased in metal housings on octal tube base. S.P.D.T. contacts. 2 coils, 700 and 3300 ohms. Operating current coils seriesed 6.6 MA releasing at 5.2MA. Operating life 1000 hrs. at 60 operations per sec. Use for • High speed keying • tabulating • sorting and computing machines • Relay amplifiers • Vibrator supplies • Servo Mechanisms, etc.

Send for 4 page technical data

$4.75 ea.
Brand New

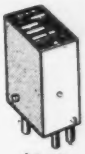
SWEEP GENERATOR CAPACITOR

High speed ball bearings. Split stator silver plated coaxial type. 5-10 mmfd. Brand new.....$2.75

CRYSTAL DIODE

Sylvania 1N21B. Individually boxed and packed in leaded foil. Brand new.$2.00

TWO-IN-ONE CRYSTAL UNITS
Bendix type MX-9E



Each unit contains 2 crystals differin in freq. by 455 kc. Following frequencies available:

2457-2912	4287-4742
2481-2936	4310-4765
2530-2985	4360-4815
2539-2994	4435-4890
2560-3015	4702.5-5157.5
2562.5-3017.5	4713-5168
2407-2862	4930-5385
2945-3400	4935-5390
3820-4275	4975-5430
3860-4315	5080-5535
4002.5-4457.5	6485-6940
4175-4630	6515-6970
4242.5-4697.5	

$1.65
Brand New

Special price in lots of 100

WESTERN ELECTRIC CRYSTAL UNITS
Type CR-1A/AR

Available in quantity—following frequencies

5910—6350—6370—6470—6510
6610—6670—6690—6940—7230
7350—7380—7390—7480—7580
9720—Kilocycles

Brand New **$1.00**

SOUND POWERED FIELD SETS
Type TP-3

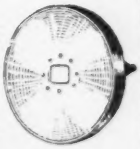
Contained in serviceable canvas cases. Brand new—export packed Per unit as illustrated.....$24.50

SOUND POWERED BATTLE PHONES

Western Electric Type 0 #D173312. Brand new in original cartons.

Per unit as illustrated.....$19.50

PARABOLOIDS



Spun Magnesium, 17½" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear. 1⅛" x 1⅛" opening in center.

Brand new per pair $8.75

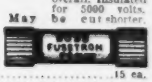
TUBE HEATERS

Type WAAGE
100 watts
Brand new
.50

High Voltage Terminal Strips

9 Terminal with bakelite barriers .10 ea.
5" x 1" x 1" high overall. Insulated for 5000 volts, be cut shorter.

50 AMP. FUSETRONS
Bus type FRN 50



For 250 volts or less.....15 ea.

All prices indicated are F O B Tuckahoe, New York. Shipments will be made via Railway Express unless other instructions issued.

ELECTRONICRAFT
INC.
5 WAVERLY PLACE TUCKAHOE 7, N. Y.
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All merchandise guaranteed. Immediate delivery, subject to prior sale.

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IMMEDIATE DELIVERY • LOW PRICES • FULLY GUARANTEED

REMOTE INDICATING Compass System

Type AN5730-2 Indicator and AN5730-3 Transmitter 26 volts, 400 cycle.

Stock ≠S-22
Special Price $6.95 each

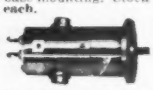
SPECIAL

Eastern Air Devices Type J33 Synchronous Motor 115 V., 400 cycle, 3 phase, 8,000 r.p.m. **Price $8.00 each net.**

D. C. MOTORS

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 3600 rpm. Cont. duty, 2½" diam. x 5½" lg. ⅜" shaft extension. 5/32" diam. 4 hole base mounting. Stock ≠SA-94. **Price $4.75 each.**



12 V.D.C. Motor John Oster B-9-2

1.4 amps.
5600 rpm.

1¾" Diam. x 3¾" Lg. Spline shaft. C. W. rotation. Stock ≠SA-48. **Price $1.95 each.**

SA-270

SA-272

General Electric 2 RPM Motor. Type 5BA10FJ228. 27 v. D-C @ 0.6 amps. 10 lb/in torque at 2 rpm. Shunt wound. I-C noise filter. Stock ≠SA-272. **Price $6.75 each.**

General Electric ½ HP D-C Motor. Type 5BA50LJ66. Armature voltage 60 v. max. field 27 v. Armature current 9.25 amps. field 2.3 amps. 4600 rpm. 7" lg. x 4¼" diam. with 2½" worm gear shaft ⅝" diam. Stock ≠SA-270. **Price $8.50 each.**

C-1 AUTOPILOT COMPONENTS

Vertical Gyro Control
Servo Amplifier
Servo Motor
Inverter
Control Panel
Directional Panel

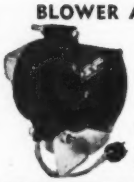
Prices on request.

ALSO IN STOCK

Sperry A5 Vertical Gyro. Part No. 644841, 115 volts, 400 cycle, 3 phase.

Sperry A5 Directional Gyro. Part No. 656029, 115 volts, 400 cycle, 3 phase.

BLOWER ASSEMBLY



WESTINGHOUSE FL BLOWER

115 v. 400cy. 17 c.f.m. Includes capacitor. Stock ≠SA-144. **Price $3.75 each.**

MINIATURE DC SELSYN INDICATOR

Miniature indicator. 24 v. d-c operation. Use with G.E. Position Transmitter or with Ohmite 360° type potentiometer. Has iron plug for zero dial adjustment. Stock ≠SA-248. **Price $6.25 each.**

INVERTER SPECIALS

General Electric PE-218 D—Input 28 v. d-c @ 92 amps. Output 115 v. 400 cycles @ 1500 va. Power factor 0.80. Shipping wt. 100 lbs. New—Original Cartons. Stock ≠SA-112. **Price $29.50 each.**

Leland or Russel PE-218 E or PE-20 SH. Similar to PE-218D. Stock ≠SA-112A. **Special Price $19.50 each.**

Leland SD-93—(10285)—Input 28 volts DC at 60 amps. Output 115 volts three phase 400 cycles at 750 va. 0.80 P.F. Second output voltage of 26 volts 400 cycles at 50 V.A. Voltage and frequency regulated. Designed for use with various autopilots. Stock ≠SA-209. **Price $79.50 each**

Holtzer Cabot MG-149H—Similar to MG-149F but draws 44 amps DC at 28 v. Output ratings are at 0.80 P.F. Equipped with high altitude brushes. Stock ≠SA-4. **Price $34.50 each**

General Electric 5D21NJ3A — Input 28 volts DC at 35 amps. Output 110 volts 400 cycles. 485 V.A. at 0.80 P.F. Weight 15 lbs. Stock ≠SA-41. **Price $9.95 each**

DC SERVO MOTORS

C-1 Autopilot Servo Unit—28 v. DC Shunt motor. 2250 rpm. 2 magnetic clutches, reduction gear, differential and 2 magnetic brakes. Output shaft 15 rpm. Torque 225 in/lbs. Stock ≠SA-180. **Price $19.50 each**

Elinco B-64 DC Servo Unit—30 v. DC max. armature voltage, 27.5 v. field. 1/165 h.p. 3100 rpm. Field current 200 ma. Armature current 260 ma. at normal torque. Stock ≠SA-211. **Price $12.50 each**

Bodine NYC-13 AC Motor

115 v. 60 cycles. 1/40 hp. 1800 rpm. Cont. duty. 55 amps. Stock ≠SA-245. **Price $9.50 each.**

MICROWAVE ANTENNA

AS-217-APG 15B. 12 Cm dipole and 13 inch Parabola housed in weatherproof Radome 16" dia. 24 v. DC spinner motor for conic scan. Stock ≠SA-95. Shipping wt. 70 lbs.

Price $6.95 ea.

Remote Position Indicating System

6-12 v. 60 cycles 5 inch indicator with 0 to 360 dial. Heavy duty transmitter. Stock ≠SA-115. **Price $9.95 per system**

SELSYN SPECIAL

Type **XXI** 115 V, 60 cycle repeater. 2½" diam. x 2½" lg. Use as transmitter or repeater. Stock ≠SA 42. **Price $4.75 each**

DC GENERATOR

Ford Instrument Co. Compound Wound. Bu. of Ordnance dwg. 223128. 115 v. d-c @ 75 amperes. Cont. duty. Ideal for laboratory use. **Special low price $2.95 ea.** Stock ≠SA-258.

SERVO MOTORS

Pioneer Type CK-2.

26 v. 400 cycles fixed phase, var. phase 49 v. max. 1.05 in/oz. Stall torque. Rotor moment of inertia 7 gm/cm; With 40: 1 gear reduction.

Stock ≠SA-97A. **Price $6.50 each.** Also available less gear train as Stock ≠SA-97. **Price $4.25 each.**

MERCURY CONTACT RELAY

W.E. D-168479

Millisecond switching at up to 60 cycles per sec. Ideal for servo amplifiers of relay type. 4 page brochure on request. Stock ≠SA-259. **Price $4.75 each.**

ELECTRONIC DESIGNING & MANUFACTURING FOR INDUSTRY

Prices F.O.B. Paterson
Phone ARmory 4-3366
Teletype PAT. 199

Servo-Tek products co.
4 Godwin Ave. Paterson, N. J.

WRITE FOR LISTING

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

D. C. MICROAMMETERS

0-100 **Weston** 301, 3" S-B.....$14.50
0-200 **W.H. NX** 35, 3" R-B MR35W200DCUA..$ 8.50
0-500 **Weston** 301, 3" S-B.....$11.00
0-500 **Weston** 506, 2" R-B, Spec black scale calibrated 0-150%, Luminous Numbers.....$ 4.00

D. C. AMMETERS

0-1.5 **Weston** 301, 3" sq fl bake case.....$6.50
0-2 **Simpson** 25, 3" R-B.....$4.00
0-5 **Gruen** 531, 2" R-B.....$3.50
0-8 **McClintock** MD2001, 2" R-B.....$3.50
0-8 **Simpson**, 2" R-B.....$3.95
0-10 **Weston** 301, 3" S-B.....$6.50
0-15 **Sun** AP-381, 3" R-B.....$3.50
0-15 **Triplett** 321 T, 3" R-B.....$4.00
0-15 **Weston** 301, 3" S-B.....$6.50
30-0-30 **Geede**, 2" R-M.....$2.95
30-0-30 **G.E.** DW-51, 2" R-M.....$3.50
0-40 **Sun** AP-598, 3" R-B.....$4.95
0-50 **Triplett** 0221 T, 2" R-B, W/50 M.V. ext shunt.....$4.50
0-150 **Simpson** 125, 2" R-M with shunt.....$5.50
0-200 **Weston** 506, 2" R-B with shunt.....$7.50
200-0-200 **Weston** 506, 2" S-B W/Ext 50 M.V. shunt.....$7.50
0-300 **G.E.** DW-51, 2" R-B with shunt.....$7.50
0-500 **G.E.** DW-51, 2" R-B less shunt.....$3.50

D. C. VOLTMETERS

0-3 **Simpson** 127, 2" R-M ring mtd.....$2.00
0-5 **W.H. NX**-33, 2" R-B 200 r/v.....$3.50
0-10 **Sun** 2AP458, 2" R-B 100 r/v.....$2.50
0-15 **McClintock** D-100 R-1, 2" R-B black scale 1000 r/v.....$3.00
0-30 **Dejur** Amsco 210, 2" R-B.....$2.50
0-30 **G.E.** DW-41, 2" R-B 250 r/v.....$2.95
0-30 **Triplett** M102, 2" R-B, black sc W/pointer set, A.C. type R-1.....$4.00
0-30 **Weston** 301, 3" S-B, 1000 r/v.....$7.50
0-40 **Sun** 3AP507, 3" R-B, 100 r/v.....$4.95
0-100 **Weston** 643, 2" Surf mtd non flanged case.....$9.00
0-150 **G.E.** DW-51, 2" R-B Special scale.....$3.95
0-150 **Simpson** 23, 3" R-M.....$6.00
0-150 **Weston** 301, 3" R-B Surf mtd 200 r/v.....$4.50
0-300 **Weston** 301, 3" S-B, 1000 r/v.....$9.50
0-500 **Sun** 3AP350, 3" R-B, 1000 r/v MR35W500DCVV.....$7.00
0-500 **Weston** 301, 3" S-B, 1000 r/v.....$9.50
0-750 **Weston** 301, 3" S-B, 1000 r/v.....$11.00

A.C.-D.C. VOLTMETER

WESTON 341

0-150 Volts. Electrodynamometer type, ¼ of 1% Accuracy on D.C. AND A.C. FROM 25 to 1200 CYCLES. Indicates true r m s voltage. Shielded movement. 3.9 V.A. power consumption. Complete in mahogany carrying case with cover. Even though these instruments are Brand New Surplus, we had Weston check each and every unit and furnish a NEW Certificate to guarantee the accuracy of each instrument. Ideal for use in conjunction with Model 311 Potential Transformer to extend the range to 750 & 1500 volts.

New in original manufacturers boxes.

List Price $226.50 **Your Cost Only $115.00**

TESTED NEW PANEL METERS

EACH METER TESTED BEFORE SHIPMENT. CALIBRATIONS ARE FOR NON-MAGNETIC PANELS. IF METERS ARE FOR USE ON MAGNETIC PANELS SPECIFY PANEL THICKNESS AND WE WILL CALIBRATE ACCORDINGLY AT NO EXTRA CHARGE. All meters have white scale and are flush mounted unless specified otherwise.

S—Square	M—Metal	sc—scale	
R—Round	r/v—Ohms per volt	surf—surface	
B—Bakelite	bl—Black	mounted	

A. C. AMMETERS

0-10 **G.E.** AO-25, 3" S-B, expanded between 4 & 7 Amps. Scale calibrated 0-100 Amps. For Direct Reading divide scale reading by 10.....$4.95
0-30 **Triplett** 331-Jp, 3" R-B.....$4.00
0-30 **Triplett** 332-JP, 3" R-M.....$4.50
0-50 **G.E.** AO-22, 3" R-B.....$4.50
0-50 **W.H.** NA-35, 3" R-B.....$4.50
0-60/120 **Burl** 32NC, 2" R-B W/Ext Trans.....$7.50
0-150 **G.E.** AO-22, 3" R-B, 5 Amp mvt, w/Ext Trans.....$7.50

A. C. VOLTMETERS

0-15 **G.E.** AW-41, 2" R-B bl sc, Signal Corps IS-122.....$2.50
0-15 **G.E.** AO-22, 3" R-B bl sc.....$3.00
0-15 **Weston** 476, 3" R-B.....$4.50
0-15 **W.H.** NA-35, 3" R-B.....$3.95
0-40 **Weston** 517, 2" R-M 400 cycles.....$3.50
0-40 **W.H.** NA-35, 2" R-B 400 cycles.....$3.50
0-75 **Weston** 517, 2" R-M ring mtd.....$2.95
0-150 **Weston** 517, 2" R-B.....$4.50
0-150 **G.E.** AO-25, 3" S-B.....$5.50
0-150 **Triplett** 332-JP, 3" R-M.....$4.00
0-150 **Triplett** 331-JP, 3" R-B.....$4.50
0-150 **Triplett** 331-JP, 3" R-B W/Resistor for 300 volts.....$5.50
0-3300 **Triplett** 232-C, 2" R-M.....$6.00
0-300 **Burlington** 22A, 2" R-M.....$6.00

D. C. KILOVOLTMETERS

All meters are furnished complete with precision, wire wound, 1000 ohms per volt, hermetically sealed multipliers and mounting clips.

0-1 **Weston** 301, 3" S-B.....$9.00
0-1.5 **W.H. NX** 35, 3" R-B, 1 MA mvt W/resistor.....$7.50
0-1.5 **Weston** 301, 3" S-B.....$9.50
0-2 **Weston** 301, 3" S-B.....$10.50
0-2.5 **Weston** 301, 3" S-B.....$9.50
0-3 **Weston** 301, 3" S-B.....$10.50
0-3.5 **Weston** 301, S-B.....$11.50
0-4 **Weston** 301, 3" S-B.....$12.00
0-5 **Weston** 301, 3" S-B.....$14.00
0-10 **Weston** 301, 3" S-B.....$15.00
0-20 **Weston** 301, 3" S-B.....$22.50

PORTABLE TACHOMETERS

0-20,000 RPM Range, Jaeger #45 A-6 Chronometric type.....$24.50

300-1200, 1000-4000, 3000-12000 RPM, Jones Motorola Co., Multiple Range, Continuous Indicating.....$24.50

300-1500, 1000-5000, 3000-15000 RPM, Jones Motorola Co., Multiple Range, Continuous Indicating.....$25.50

CURRENT TRANSFORMER, Weston 539, 2.5/10/20 Amps tapped and 50/100/200 Amps inserted primary. Secondary 1 Amp.
List Price **$61.50** Your Cost Only **$26.50**

CURRENT TRANSFORMER, Weston 461-4 5 Amp Secondary. Primary 50/100/200/250/500/1000 Amps., 15 V. A. Capacity.
List Price **$98.00** Your Cost Only **$35.00**

POTENTIAL TRANSFORMER, Weston 311 Potential ratio of 1500 & 750 to 150 volts. 15 VA Capacity.
List Price **$247.50** Your Cost Only **$90.00**

BOWL INSULATORS. Clear Glass, Corning Glass Works No. 67676. Type C Comprises flanged bowl, 4 ⅝" h x 6 15/16" O.D. at base. Center lead-in bin ⅝" dia. Overall dia 8 ¾". All brass fittings. S.C. Stock # 9G-1850-67676.....$6.00

GASOLINE HEATER MOTOROLA MODEL GN-5-24A. Internal Combustion type 15,000 B.T.U., operates on 24-28 volt D.C. Can be used with transformer and rectifier for 110 V A.C.....$22.50

BC-1160-A TRANSMITTER. 157 to 187 Megacycles. 117 volt 60 cycle 10 tubes.....$29.50

BC-1161-A RECEIVER. 150 to 210 Megacycles. 117 volt 60 cycle 14 tubes.....$34.50

CARBON PILE D.C. VOLTAGE REGULATOR. Safety Car Heating & Lighting Cat # 20540. Type S 7004.....$65.00

THERMAL CIRCUIT BREAKER, D.P.S.T. 15 Amp. 120 Volt A.C., Curve D. Heineman #3022.....$1.50

TERMINAL BOARD with barrier strips, 6 Terminals with 2 connection points each 1½" long x 2" W x 1½" H, minimum order 10 pieces.....$.50

STRIP HEATERS, 50 Watt, 115 volt, 250 ohms, 1½" x 5½"x6" O.E. Catalog #2A504, minimum order 10 pieces.....$.60

R. F. AMMETERS

0-120 **MA Simpson** 25, 2" R-B.....$7.50
0-250 **MA R.F.,** W.H. NT-33, 2" R-B, Sc cal 0-5 Antennae Current.....$3.50
0-1 **G.E.** DW-44, 2" R-B bl sc.....$2.95
0-1 **G.E.** DW-44, 2" R-B.....$3.50
0-1 **G.E.** DW-52, 2" R-B.....$3.00
0-1 **G.E.** DO-44, 2" R-B.....$11.00
0-1.5 **G.E.** DW-52, 2" R-M bl sc.....$2.95
0-1.5 **Weston** 425, 3" R-B.....$8.25
0-2 **Simpson** 135, 2" R-B.....$3.50
0-2 **Weston** 425, 3" R-B.....$8.50
0-2.5 **Weston** 507, 2" R-B.....$3.95
0-2.5 **Simpson** 35, 3" R-B.....$4.95
0-2.5 **Weston** 425, 3" R-B.....$8.50
0-2.5 **W.H. NT-35,** 3" R-B.....$5.50
0-3 **W.H. NT-35,** 3" R-B.....$5.50
0-3 **Weston** 425, 3" R-B.....$8.50
0-3 **Weston** 425, 3" R-B W/Ext couple.....$9.50
0-5 **G.E.** DO-44, 2" R-B W/Ext couple.....$8.50
0-5 **G.E.** DO-44, 3" R-B.....$7.50
0-5 **W.H. NT-35,** 3" R-B.....$7.00
0-6 **G.E.** DW-44, 2" R-B, bl sc.....$2.50

D. C. MILLIAMMETERS

0-1 **G.E.** DO-41, 3" R-B.....$6.00
0-1 **W.H. NX**-35, 3" R-B MR35W001DCMA..$7.50
0-1 **Weston** 301, 3" S-B.....$7.50
0-3 **Gruen** GW-580, 2" R-B.....$3.50
5-0-5 **Western Electric,** 3" R-B, concentric style..$3.00
0-10 **Weston** 301, 3" S-B.....$6.50
0-20 **G.E.** DW-55, 2" R-B black scale.....$3.00
0-30 **G.E.** DO-41, 3" R-B.....$3.50
0-80 **G.E.** DO-41, 3" R-B.....$3.75
0-150 **Gruen** 508, 2" R-B.....$3.00
0-200 **G.E.** DO-41, 3" R-B.....$4.50
200-0-200 **G.E.** DO-40, 3" R-B, ring mtd non-flanged case.....$4.00
0-500 **W.H. NX**-33, 2" R-B.....$3.95

AIRCRAFT METERS

All aircraft meters listed are 2½" type with black scales.

30 Volt **Weston** 606.....$4.50
30 Volt **Westinghouse** AX-33.....$4.50
30-0-30 Amp **Weston** 606.....$5.00
120 Amp **Weston** 606 W/ext shunt.....$5.00
120 Amp **Westinghouse** AX-33 W/ext shunt.....$5.00
240 Amp **Westinghouse** AX-33 W/ext shunt.....$6.50
240-0-240 Amp **General Electric** W/ext shunt..$6.50
30 Volt 60 Amp, **G.E.** W/ext shunt, AN Conn. Type.....$5.50
30 Volt 120 Amp, **Westinghouse** AX-33 W/ext shunt.....$6.00
30 Volt 120 Amp, **General Electric** W/ext shunt, AN Conn. Type.....$5.50
30 Volt 240 Amp, **Westinghouse** AX-33 W/ext shunt.....$7.50

COMBINATION OFFERS

150 VOLT A.C. & 30 AMP A.C. **Triplett** Model 331-JP, 3" Rd flush bake case. BOTH METERS FOR.....$7.95
40 VOLT D.C. & 40 AMP D.C. **Sun** Model 3AP597-S 3" Rd flush bake case. BOTH METERS FOR **$9.25**

SPECIAL METERS

SENSITROL RELAY. 0-50 Microampere sensitivity, Weston 705 type 5, Single fixed contact with 110 volt AC solenoid reset and adjustable index to indicate operating point. Has two scales, one for setting index, the other for reading pointer position. Contact closes on decreasing value and has a capacity of 5 Watts at 110 volts.
List Price **$68.50** Your cost ONLY **$27.50**

FREQUENCY METER, 55 to 65 cycles, James Biddle Co., type MF-11 Frahm vibrating reed type, 11 reeds, 100 to 150 volt operation, 3½" round flush bakelite case.....$7.50

FREQUENCY METER, JBT 30-F, Dual Range covers frequency ranges from 48-52 cycles and 58-62 cycles. Dual element, vibrating reed type 112 volt, 3½" rd flush metal case.....$9.95

DECIBEL METER, Weston 301 type 61, minus 10 to plus 6 DB, 2½" rd fl bake case, 6 MW 600 ohms. High speed type, with 3 external wire wound multipliers to extend range.....$11.50

DECIBEL METER, Weston 506, minus 10 to plus 6 DB, 2½" round flush bakelite case, Black scale, luminous markings.....$4.50

PORTABLE A.C. AMMETER 0-3 and 0-15 Amps A.C., Weston Model 528. Complete with leather carrying case and test leads.....$12.50

ALL ITEMS ARE BRAND NEW SURPLUS GUARANTEED UNLESS SPECIFIED OTHERWISE. All materials shipped from stock same day as order received, subject to prior sale. Orders accepted from rated concerns, public institutions and agencies on open account, others please send 25% deposit, balance C.O.D. or check with order. All prices FOB our warehouse, N.Y.C.

MARITIME SWITCHBOARD
338 CANAL STREET
NEW YORK, 13, N. Y.
Worth 4-8217

We carry a complete line of surplus new meters suitable for every requirement, such as portable, panel, switchboard, laboratory standard, etc.

Over 50,000 METERS in Stock

We carry a wide assortment of aircraft type electrical meters, precision tubular multipliers and meter shunts. Your inquiries will receive our prompt attention.

BARGAINS FROM

AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

Esco AC Motors; built-in magnetic brake for quick reversing. Double shaft, ball bearings. Rated: 2½ HP—30 minutes, marine duty; 440-3-60. Brand new in original cases. ..... **SPECIAL PRICE $28.50**

General Electric Synchronous Motor or Alternator; excitation 2 Volts; operating at or delivering 110 volts, 3 phase, 60 cycles at 1800 speed; no name plates, but lab tests determined specs as above..... **$9.50**

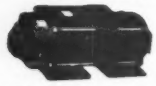
General Electric or Westinghouse DC Motors; 1/6 HP 110 Volts, DC. 1750 RPM. Rebuilt **$8.35**

General Electric Type B Flange Motor for hoisting duty. 6 ¾ H. P. separately excited. Marine Duty. Brand New, original cases; 235 Volts, DC. 1100 RPM..... **$65.00**

Special Series Motors; no name plates; ¼ HP operate at either 110 Volts DC or AC; ½" shaft. Repainted **$9.85**

General Electric "Variac type" Controllers; 600 watts; 110/220 designed as an adjustable speed controller but can be used for any application requiring a variable transformer. Brand new and an exceptional buy at **$12.00**

GEN. ELECTRIC AMPLIDYNES



Model 5AM78AB50A; 1500 watts Input: 440-3-60; Output: 250 Volts, DC; 6 amperes; 3450 RPM..... **$225.00**

Model 5AM78AB16; 750 watts; Input: 440-3-60; Output: 250 Volts, DC; 3 amperes; 3450 RPM **$115.00**
Coupled directly to control motor on common base. Brand new..... **$185.00**

Model 5AM49AB16; 250 watts; Input: 440-3-60; Output: 250 Volts, DC; 1 ampere. 3450 RPM **$55.00**

WESTINGHOUSE TRANSFORMERS

300 VA: 115/240 Volts; Brand New. **SPECIAL PRICE** **$3.35**

FLEXARC TRANSFORMER TYPE WELDER

Operates at 440/550, single phase, 60 cycles. 300 ampere adjustable output. Rebuilt like new. **SPECIAL PRICE**..... **$119.75**

ELECTRIC SPECIALTY DC TO DC MG UNITS

Operate at 220 Volts, DC to deliver 110 Volts, 3.5 amperes. Two of these units can be used on 220 VDC to obtain 110-0-110 Volts DC. **Special Price**..... **$15.54**

MARATHON MOTOR GENERATORS

Input at 110 VDC Output 110VAC, 1 phase, 60 cy. 500 VA. Marine Type with voltage regulator and frequency controller. Rebuilt LN **$65.00**
Same unit as above with 32 VDC Input and 300 VA Output **$54.00**

KATO ROTARY CONVERTERS

Type 1205A Model 26KA54. Input: 24 VDC, 28A. 1800 RPM. Output: 115 VAC 1 phase 60 cy. 1 KVA. Compact and ruggedly built for cont. duty oper. Filtered. Shock mounted. New..... **$90.00**

WESTINGHOUSE TRANSFORMERS

1 KVA; Type JR; 460/230-230/115. Brand New **$17.50**

GEN. ELECTRIC TRANSFORMERS

1 KVA; Type JR; 460/230-230/115. Brand New **$19.60**

General Electric 5 KVA Autotransformers; 110/220; Brand New **$26.00**

CENTURY MOTOR GENERATOR SETS

7.5 KVA; 230 Volts, DC to 115 Volts, AC, single phase, 60 Cycles. Complete with automatic controller and push button station **$145.00**

GENERAL ELECTRIC DC/AC MG SETS

Four Bearing Marine Units; 25 HP 230 Volts, DC coupled to alternator 18.75 KVA; 80% PF; 1800 RPM Ball Bearings. 4 bearing set; marine duty. Brand New. **$345.00**

INDUCTION VOLTAGE REGULATOR

Type IRT, form M, 1.64 KVA, 3 phase, 60 cycles, cont. duty. Outdoor service. Primary: 208 V., 10.5 load amps. Oil-filled. Wgt. 365 lbs. 33 x 17" x 14" **$83.00**

G. E. Motor CONTROLLED VOLTAGE REGULATOR

Cat. #837625, Type AIRS, Form M, .568 KVA, cont. duty, 60 cy., primary volts 115, Load Amps 16.2. Indoor service. Voltage controlled by mtr. 120/1/60.1/40 HP..... **$39.50**

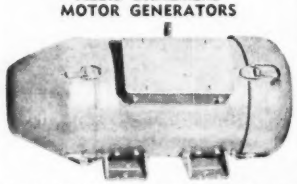
LELAND-MURRAY HIGH FREQ. MOTOR GENERATOR SETS

2 KVA; 115 Volts, 400 cycles; 17.2 amperes; single phase, coupled to 220/440-3-60 motor **$250.00**
Same specifications but operative with single phase, 110/220 Volt Motor.... **$295.00**
3 KVA; 120 Volts, 3 Phase, 400 cycles, coupled to 220/440-3-60 Motor..... **$335.00**
Same unit with 5 HP-110/220 Volt Motor **$415.00**

G. E. OIL FILLED OUTDOOR TRANSFORMER

Brand New. 3 KVA; Type HS 3000/5200Y-115/230. **SPECIAL PRICE. Brand New**..... **$36.00**

ALLIS CHALMERS MOTOR GENERATORS



Input: 115 VDC at 14 amp. 3600 RPM. Ball Bearings. Output: 1.25 KVA; 80% PF 120 Volts, AC. 1 Ph. 10.4 amp. Centrifugal automatic controller permits line-start operation. Fully enclosed. **Brand New $99.95.** Also available for 230 VDC operation at the same price.

G. E. ROTARY CONVERTERS

Dynamotor Model 5D46AB8 78 Volts, DC input to deliver 110 Volts, AC, single phase, 60 cycles, 1.5 amp. **SPECIAL PRICE (Rebuilt) $9.95**

HOLTZER-CABOT MG149F

Input 28 Volts, DC at 36 amps. Output 26 Volts at 250 V. A. 400 cps. and 115 Volts at 500 V. A., 400 cycles. Rebuilt like new **$24.75**

HOLTZER-CABOT 153F

Input: 28 Volts DC at 52 Amp. Output: 115 Volts, 400 cps. 3 phase, 750 va; .9 P. F. also secondary output of 26 Volts, 400 cycles, single phase at 250 va; voltage and frequency regulated. **REBUILT LIKE NEW $59.50**

HERE IS EXCEPTIONAL VALUE

We have just purchased 1000 Westinghouse Motor Controllers, each contains a 110/220 Volt transformer with multitaps and switch, originally designed for control of Type FL Motors. Sold for less than the value of the transformer alone. Brand New. **SPECIAL PRICE** **$6.25**

A. T. R. INVERTERS

250 Watts, 110 VDC to 110 VAC. Brand New **$18.75**

PINCOR ROTARY CONVERTERS

300 VA; Filtered; Brand New. Input: 115 VDC, 4.2 Amp. Output: 220 VAC, 1.36 Amp. **SPECIAL PRICE** **$38.00**

GENERAL ELECTRIC DC GENERATORS; Type BD; 1 ¾ K. W. 125/125 Volts, 14 Amp. 1800 Speed. Rebuilt..... **$65.00**

RAYTHEON CONSTANT VOLTAGE TRANSFORMERS; Brand New. Input: 190-260 Volts, 1.75 Amps. Output: 230 Volts, 250 watts, 100% P. F..... **$18.00**

WESTINGHOUSE MG UNITS. Compact two bearing sets with repulsion-induction Motor operative at 110/220 Volts, single ph. 25 cycles; 1425 RPM; Output: 40 Volts, 2 Amperes, DC, Compound winding. Rebuilt. A remarkable value at..... **$16.75**

IDEAL MOTOR GENERATOR SETS; Rebuilt like new. Operative at 110/220 Volts, single phase to deliver 120 VDC; 300 watts, Complete with field rheostat..... **$65.00**

FIELD RHEOSTATS; 11 ohms, 8 amperes, 8" Plate, brand new..... **$5.00**

ESCO MG UNIT, DC/DC. Operates at 220 Volts, DC to deliver 110 Volts, DC, 3.5 Amperes. Two units with output connected in series provides isolated 110-0-110 from two wire DC. Rebuilt..... **$15.54**

RAYTHEON HIGH VOLTAGE TRANSFORMERS; Pri: 214/246 Volts; Sec: 5500 Volts, 1.0 ampere; test 13,500 V. Brand New **$72.00**

RAYTHEON DISTRIBUTION TRANSFORMERS; .75 KVA; Pri: 220/440; Sec: 110 Volts, Single phase, 60 cycles. Brand New **$12.50**

ESCO DC/AC MG SETS. Motor: 115 Volts, 1½ HP, line start; built in voltage regulator, frequency control, filtered; ideal for television, radar or any application requiring constant voltage and frequency. Brand New **$120.00**

G. E. Motor Starting Reactors Type 11K284062; Rated at 440V, 3 Ph. 60 Cy. 16.8 Amp. Only a 3 Pole Double Throw Switch is necessary with this unit to make a 15-20 HP compensator starter. Useful for any purpose requiring three phase choke. **SPECIAL PRICE**..... **$9.90**

IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC;

IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

Established in 1922 ***Tel HAncock 6-1288***

WILLIAM I. HORLICK COMPANY

228 PURCHASE ST. **BOSTON 10, MASSACHUSETTS**

DON'T pass THIS AD

for these

"Once in a LIFE time"

values..

● TYPE "J" POTENTIOMETERS

No better pot at any price, no source more complete than Life Electronic Sales.

Available in screw-driver and regular shafts locking and non-locking type bushings.

When ordering locking type bushing potentiometers, locking nuts are available at $.05 each.

Type "J" pots available in the following values from stock.

Specify whether regular or screwdriver shaft is required.

Ohms	Single Pots Ohms	Ohms	Ohms	Dual Pots.
50	1000	10000	60000	3000
60	1300	15300	70000	10000
150	1500	20000	100000	25000
200	2000	22000	200000	50000
250	2500	25000	250000	100000
400	3000	30000	500000	500000
500	5000	35000	600000	1 Meg.
600	6500	50000	1 Meg.	5 Meg.

Price each Single Pots $.50 Dual Pots $1.50

● CRYSTAL DIODES

Type	Design Freq. (mc)	Max. Conv. Loss(db)	Max. Output Noise Ratio	Burnout Test	I. F. Imp. (ohms)	Price each
1N21	3,000	8.5	1.0	Bs = 0.3 erg	200–800	$.50
1N21B	3,000	6.5	2.0	Bs = 2.0 erg	200–800	1.00
1N23	10,000	10.0	3.0	Bs = 0.3 erg	150–600	1.25
1N23A	10,000	8.0	2.7	Bs = 1.0 erg	150–600	1.50
1N23B	10,000	6.5	2.7	Bs = 0.3 erg	150–600	2.00

SILICON DIODES

GERMANIUM DIODES

Type	Cont. Rev. Working Volt.	Peak Back Voltage*	Fwd. Cur. at + 1v (ma min.)	Av. Anode Cur. (ma max.)	Recurrent Peak Anode Cur. (ma max.)	Rev. Cur. (μa max.)	Price each
IN34	60v max.	75v min.	5.0	40	150	50 @ —10v 800 @ —50v	$.85
IN35	50v max.	75v min.	7.5	22.5	60	10 @ —10v	2.00

● UG TYPE CONNECTORS

AN No.	Price ea.	AN No.	Price ea.	AN No.	Price ea.
UG9/U....	$.95	UG60/U....	1.90	UG174/U...	16.00
UG10/U....	1.86	UG60AU....	1.30	UG188/U...	.95
UG11/U....	1.45	UG61/U....	2.05	UG195/U...	.75
UG12/U....	.95	UG61AU....	1.80	UG197/U...	5.00
UG13/U....	1.36	UG62/U....	28.00	UG201/U...	1.83
UG14/U....	1.45	UG83/U....	1.50	UG202/U...	2.75
UG15/U....	.95	UG85/U....	1.65	UG204/U...	2.25
UG16/U....	1.36	UG86/U....	1.69	UG206/U...	1.02
UG17/U....	1.45	UG87/U....	1.40	UG208/U...	28.00
UG18/U....	.99	UG88/U....	1.17	UG212/U...	4.50
UG18/AU...	1.05	UG89/U....	.95	UG213/U...	4.50
UG19BU....	1.09	UG90/U....	1.05	UG215/U...	3.35
UG19/U....	1.28	UG91/U....	1.25	UG216/U...	8.70
UG19AU....	1.38	UG91AU....	1.05	UG217/U...	2.10
UG19BU....	1.45	UG92/U....	1.10	UG218/U...	6.50
UG20/U....	1.17	UG92AU....	1.35	UG222/U...	35.00
UG20AU....	1.26	UG93/U....	1.25	UG231/U...	2.00
UG20BU....	1.41	UG93AU....	1.45	UG235/U...	28.50
UG21/U....	.99	UG94/U....	1.25	UG236/U...	11.75
UG21AU....	1.05	UG94AU....	1.05	UG241/U...	2.20
UG21BU....	1.09	UG95/U....	1.10	UG242/U...	2.50
UG22/U....	1.08	UG95AU....	1.35	UG243/U...	2.75
UG22AU....	1.38	UG96/U....	1.25	UG244/U...	2.50
UG22BU....	1.34	UG96AU....	1.45	UG245/U...	1.25
UG23/U....	.99	UG97/U....	3.50	UG246/U...	1.85
UG23AU....	1.26	UG98/U....	1.55	UG252/U...	4.50
UG23BU....	1.29	UG100/U...	2.34	UG254/U...	1.82
UG27AU....	2.25	UG101/U...	2.95	UG255/U...	4.50
UG28/U....	2.34	UG107/U...	2.25	UG259/U...	4.10
UG29/U....	1.22	UG108/U...	1.75	UG260/U...	.99
UG29AU....	1.36	UG109/U...	2.75	UG263/U...	.95
UG30/U....	1.75	UG114/U...	1.50	UG262/U...	1.05
UG32/U....	20.00	UG115/U...	1.33	UG269/U...	2.60
UG33/U....	20.00	UG123/U...	.45	UG270/U...	6.50
UG34/U....	17.50	UG131/U...	6.00	UG273/U...	1.50
UG35AU....	16.00	UG146/U...	2.25	UG274/U...	1.98
UG36/U....	16.00	UG155/U...	.40	UG279/U...	2.40
UG37/U....	16.00	UG154/U...	5.35	UG287/U...	5.25
UG37AU....	16.00	UG156/U...	4.25	UG290/U...	.85
UG57/U....	.99	UG157/U...	4.25	UG291/U...	1.05
UG58/U....	.65	UG160/U...	1.90	UG306/U...	2.03
UG59/U....	2.75	UG160AU...	1.55	UG333/U...	4.70
UG59AU...	1.76	UG167/U...	3.00	UG334/U...	5.75
		UG173/U...	.30	UG352/U...	6.00

● COAXIAL CABLES

RG No.	Impedance	Price per Thousand Ft.
RG5U	52.5 ohms	$70.00
RG6U	76.0 ohms	150.00
RG7U	97.5 ohms	70.00
RG8U	52.0 ohms	55.00
RG9U	51.0 ohms	135.00
RG9AU	51.0 ohms	125.00
RG10U	52.0 ohms	125.00
RG11U	75.0 ohms	160.00
RG12U	75.0 ohms	190.00
RG13U	75.0 ohms	125.00
RG18U	52.0 ohms	450.00
RG19U	52.0 ohms	350.00
RG20U	52.0 ohms	450.00
RG22U	95.0 ohms	120.00
RG24U	125.0 ohms	240.00
RG25U	48.0 ohms	575.00
RG27U	48.0 ohms	290.00
RG29U	53.5 ohms	50.00
RG34U	71.0 ohms	175.00
RG39U	72.5 ohms	180.00
RG41U	67.5 ohms	575.00
RG54U	58.0 ohms	65.00
RG54AU	58.0 ohms	75.00
RG57U	95.0 ohms	100.00
RG58U	53.5 ohms	50.00
RG59U	73.0 ohms	45.00
RG62U	93.0 ohms	50.00
RG71U	93.0 ohms	175.00
RG74U	52.0 ohms	250.00

Prices based on a minimum quantity of 500 ft. For cut lengths add 50% to prices shown.

● RESISTORS

EB½, GB1 and HB2

LIFE OFFERS THE MOST COMPLETE INVENTORY OF ½, 1 AND 2 WATT RESISTORS IN 5% and 10% TOLERANCES IN THE COUNTRY.

Stock	Wattage Tol.	Price Sched.* 1–99	100 or more
EB½	½ Watt 10%	$.06	$.04
EB½	½ Watt 5%	.12	.08
GB1	1 Watt 10%	.09	.06
GB1	1 Watt 5%	.18	.12
HB2	2 Watt 10%	.15	.10
HB2	2 Watt 5%	.30	.15

*Prices shown are "per size"

The following values available in 10% Tolerance:

Ohms	Ohms	Ohms	Ohms	Megs	Megs	Megs
10	100	1000	10000	.1	1.0	10.0
12	120	1200	12000	.12	1.2	12.0
15	150	1500	15000	.15	1.5	15.0
18	180	1800	18000	.18	1.8	18.0
22	220	2200	22000	.22	2.2	22.0
27	270	2700	27000	.27	2.7	
33	330	3300	33000	.33	3.3	
39	390	3900	39000	.39	3.9	
47	470	4700	47000	.47	4.7	
56	560	5600	56000	.56	5.6	
68	680	6800	68000	.68	6.8	
82	820	8200	82000	.82	8.2	

The following values are available in 5% Tolerance:

Ohms	Ohms	Ohms	Ohms	Ohms	Megs	Megs	Megs
10	68	470	3300	22000	0.15	1.0	6.8
11	75	510	3600	24000	0.17	1.1	7.5
12	82	560	3900	27000	0.18	1.2	8.2
13	91	620	4300	30000	0.20	1.3	9.1
15	100	680	4700	33000	0.22	1.5	10.0
16	110	750	5100	36000	0.24	1.8	11.0
18	120	820	5600	39000	0.27	2.0	12.0
20	130	910	6200	43000	0.30	2.2	13.0
22	150	1000	6800	47000	0.33	2.2	15.0
24	160	1100	7500	51000	0.36	2.4	16.0
27	180	1200	8200	56000	0.39	2.7	18.0
30	200	1300	9100	62000	0.43	3.0	20.0
33	220	1500	10000	68000	0.47	3.3	22.0
36	240	1600	11000	75000	0.51	3.6	
39	270	1800	12000	82000	0.56	3.9	
43	300	2000	13000	91000	0.62	4.3	
47	330	2200	15000	0.1	0.68	4.7	
51	360	2400	15000	0.11	0.75	5.1	
56	390	2700	18000	0.12	0.82	5.6	
62	430	3000	20000	0.13	0.91	6.2	

"UHF" COAXIAL CABLE CONNECTORS

83-1SPN No.	AN No.	Description	Ea.	Per C.
83-1SP	PL259	Plug	.35	.28
83-168	UG176U	Adapter	.15	.12
83-185	UG175U	Adapter	.15	.13
83-1SPN	PL259A	Plug	.35	.28
83-776	UG203U	Plug	.61	.55
83-1R	SO239	Receptacle	.35	.28
83-1RTY	.....	Receptacle	.50	.45
83-1H	UG106U	Hood	.12	.10
83-1HP	.....	Hood	.27	.24
83-765	UG177U	Hood	.31	.25
83-1AC	.....	Cap and chain	.61	.50
83-1BC	.....	Cap and chain	.38	.34
83-1T	M358	"T" connector	1.12	.98
83-1AP	M359A	Angle adapter	.35	.28
83-1J	PL258	Junction	.85	.79
83-1F	PL274	Feed thru	1.12	.98
83-228P	UG102U	Twin plug	.50	.40
83-22R	UG103U	Twin recept.	.50	.40
83-22AP	UG104U	Twin ang. adapt.	.98	.80
83-223	UG105U	Twin junction	1.25	1.12
83-22T	UG196U	Twin "T"	1.65	1.50
83-22F	PL275	Twin feed thru	1.50	1.35

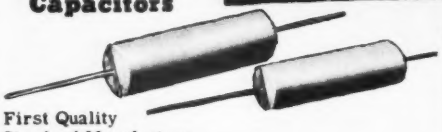
FREE! Send For our bulletin J-300

LIFE ELECTRONIC SALES 91 GOLD STREET, N. Y. 7 N. Y. DIGBY 9-4154-5

SUN RADIO & ELECTRONICS CO., INC. 122-124 DUANE ST. NEW YORK 7, N.Y.

Plastic Molded Paper Tubular Capacitors

70% and More off List Prices



First Quality
Standard Manufacture
No Surplus--But Cheaper than Surplus

Plastic molded paper tubulars at lowest net prices ever offered in recent years. Made by big-name mfr. Because Sun Radio made a huge purchase at a very low price, we can offer them at unprecedented discounts.

A new concept in paper tubular construction, these units are molded in plastic just like micas. The result: Greater stability. Better sealed. Stand higher temperature. Longer life. No wax to run while soldering. Leads firmly anchored. Moisture repellent. 600 Volt units listed here. Full line of 200, 400, 1000 and 1600 Volt units also available. See our September MONTHLY MAILER. Write today to get on mailing list.

Catalog Number	Capacity Mfd.	Size Inches dia. x length	Net Prices in Quantities of 10-100	101-500	501 & over
		600 V. D. C. WORKING			
SC2516	.00025	3/8 x1 1/8	.085	.076	.069
SC5016	.0005	3/8 x1 1/8	.085	.076	.069
SC7516	.00075	3/8 x1 1/8	.085	.076	.069
SC1026	.001	3/8 x1 1/8	.085	.076	.069
SC2026	.002	3/8 x1 1/8	.085	.076	.069
SC3026	.003	3/8 x1 1/8	.085	.076	.069
SC4026	.004	3/8 x1 1/8	.085	.076	.069
SC5026	.005	3/8 x1 1/8	.085	.076	.069
SC6026	.006	3/8 x1 1/8	.085	.076	.069
SC8026	.008	7/16 x1 1/4	.085	.076	.069
SC1036	.01	7/16 x1 1/4	.105	.092	.083
SC1536	.015	7/16 x1 1/4	.105	.092	.083
SC2036	.02	7/16 x1 1/4	.105	.092	.083
SC3036	.03	1/2 x1 1/2	.12	.107	.096
SC4036	.04	1/2 x1 1/2	.12	.107	.096
SC5036	.05	1/2 x1 1/2	.135	.122	.109
SC6036	.06	9/16 x1 5/8	.135	.122	.109
SC8036	.08	5/8 x2	.15	.135	.122
SC1046	.1	5/8 x2	.15	.135	.122
SC1546	.15	5/8 x2	.17	.153	.138
SC2046	.2	3/4 x2	.19	.17	.15
SC2546	.25	7/8 x2	.19	.17	.15
SC5046	.5	1 x2 1/8	.27	.24	.217
SC1056	1.	1 3/8 x2 5/8	.42	.38	.343

60/40 Solder tin/lead

IMMEDIATE DELIVERY
FIRST TIME IN 10 YEARS

World-famous Ersin Multi-Core solder. .064 inch diameter. #16 S.W.G.
$1.45 a lb. on 7 lb. spools

POTENTIOMETERS

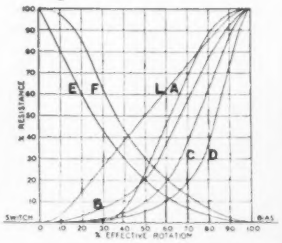
Cat. No.	Ohms
SP501L	500
SP102L	1,000
SP202L	2,000
SP302L	3,000
SP402L	4,000
SP502L	5,000
SP502A	5,000
SP752L	7,500
SP103L	10,000
SP103A	10,000
SP103E	10,000
SP103B	10,000
SP103C	10,000
SP153L	15,000
SP153A	15,000
SP153E	15,000
SP153B	15,000
SP203L	20,000
SP203A	20,000
SP253L	25,000
SP253B	25,000
SP253E	25,000
SP303L	30,000
SP403L	40,000
SP503L	50,000
SP503B	50,000
SP503C	50,000
SP753L	75,000
SP753E	75,000
SP104L	100,000
SP104C	100,000
SP204L	200,000
SP254L	250,000
SP254C	250,000
SP304L	300,000
SP504L	500,000
SP504D	500,000
SP504C	500,000
SP754C	750,000
SP105L	1,000,000
SP105C	1,000,000
SP205C	2,000,000
SP205L	2,000,000
SP305C	3,000,000
SP405C	4,000,000
SP505C	5,000,000
SP106C	10,000,000

Complete Line Of Composition Controls

47¢ each

in lots of 10 of any one type. Even greater savings on larger quantities. Ask us for quotations.

Nationally Branded. Individually boxed. No surplus. In a complete range of resistance values and tapers. 1 1/8 inch diam. x 9/16 deep. 2 1/8 inch shaft. 3/8-32 brass bushing.



Last letters in catalog numbers in table at left correspond to curves shown above.

COAXIAL CONNECTORS

A complete line of Army-Navy type UG coaxial connectors made by Kings Electronics is listed in our September Monthly Mailer. It is the only such listing available. Kings Electronics holds more type approvals under JAN C-71 and other applicable specifications than any other manufacturer. These connectors are brand new but cost no more than surplus. Write today for your copy.

Sun Radio MONTHLY MAILER

Items on this page are typical of those listed in the Sun Radio Monthly Mailer, a new publication which brings to the industrial electronics field news of new, unusual or particularly interesting items from our large, varied, and up-to-date stock. Each issue includes a page of bargains for quantity buyers. You'll like it!

To get on the mailing list for the Sun Radio Monthly Mailer, write us on your letterhead.

Sun Radio
AND ELECTRONICS COMPANY, INC.
ESTABLISHED 1933
122-124 DUANE STREET • NEW YORK 7, N. Y.
BARCLAY 7-1840

Engineering–Hand Selected–Government Surplus

EVERY ITEM PERSONALLY SELECTED BY OUR ENGINEERS

Unconditionally guaranteed.

VOLTAGE REGULATOR Manf. guaranteed 1% regulation; Primary 92-138V 57-63 cycles, 1 Phase Secondary 115V 1% regulation 96 PF Navy Gray Cabinet Shipping wt. 250 lb. Size 36x20x12 Limited quantity $97.50

STEPDOWN TRANSFORMERS 440 to 220 to 110-5 KVA. Complete encased G.E. Explo. Proof. Can be used as 4/1 or 2/1 ratio step-up or down, 60 cps. Size 20x11x10. Weight 225 lbs. Navy gray finish integral junction box and mounting frame. $75.00
220 to 110 500 Watts 60 cycles complete encased. New $11.50
Auto transformer, 220 or 110 Voltage range of 50%. Write for complete specifications $12.50

BIRD WATTMETER. 5 to 500 watts of R.F. Measures MF, HF, VHF and UHF. Write for full description. Only two units left ..... $75.00 each
DAVEN ATTENUATION BOX Model HA-740 110 DB attenuation in 1 DB steps 600/600 ohms input and output. New. Three left ..... $59.00 each

TELRAD FREQUENCY STANDARD. Self continued, dual 100/1000 Kc XTL multivibrator and harmonic Amp. Calibrate with WWV or Broadcast for high accuracy. 100 to 45,000 KC check points every 100/1000 KC. New $29.50

MEGA-SWEEP. Manufactured by KAY Electric Co. Wide range sweep oscillator. Frequency range 100 KC to 1000 MC. Sweep 30 MC. New with Instruction Manual ..... Price $275.00
SYNCROSCOPE. Browning & Sylvania P-4 and P-4E. Sweep speeds: 0.5 to 25 micro seconds per inch. Sweep Synchronization: 500 to 4000 CPS. Complete with Instruction Book. P-4 ..... $225.00
P-4E $275.00

FREQUENCY METERS

Field Strength-Frequency Meter. 1 90RM 100 to 155 Mc. Cavity Type-Battery Operated. New being used by CAA and Airlines. Complete in Case $21.50

Wave Meter-BC906D. 160 to 220 Mc. Absorption type consisting of coaxial wave meter, diode rectifier, amplifier and individual calibration charts. Complete in black crackle case with antenna $29.50
Lavoie Frequency Meter. 375 to 725 Mc. Model 1068M. 0.1% accuracy. Covers new citizen band, Aircraft, Amateur, New Television band, Government bands. Precision Equipment. Individually calibrated. Complete with instruction manual and cable. New, $59.50. Case scratched but otherwise perfect $49.50

GRID DIP OSCILLATOR. See August Issue Electronics Pg. 176, "New Products". An all around Laboratory Instrument for measurement of resonant frequency, Circuits, Q, RF, voltages, antenna and many other purposes. 3 MC. to 250 Mc. or other extended ranges. Compact and complete in kit form. Instruction book and application book sent free on request. Complete Kit $21.50

TRANSMITTER KITS

Complete to the Last Piece of Wire At Rock Bottom Prices.—Commercially Engineered.

TR-1 TRANSMITTER

300 watt input-Phone or C. W. 100% Class B Plate modulated. All bands 80-40-20-15-11-10 meters. Broad band exciter-single dial final tuning. Crystal controlled with provisions for v.f.o. A complete transmitter kit in all respects. Includes everything from crystal mike, key to antenna changes over relay. Aluminum chassis for easy cut out. Complete instruction manual, pictorial and schematic diagrams. Absolutely no other parts needed. Wire, hardware, fuses, meter, tubes, everything included. Price $179.50

TR-75 TRANSMITTER

C. W. transmitter — 75 watts input. Proven reliable circuit—6V6 driving an 807. Complete in enclosed cabinet for TVI reduction. Absolutely everything needed: Power supply, tubes, coils, condensers, meter, wire, hardware, etc. Instruction manual with pictorial and schematic. Even key is included. The c.w. man's dream comes true at the unheard low price of less than 50c per watt. Complete with power supply and tubes $34.95

MD-40 MODULATOR

40 watts audio. The modulator for our TR-75 Crystal Mike 6837 to 6J5 audio amp. Pair 6J5 drives, to push pull 616s. Standard Electro-Voice crystal mike included $29.95

MD-100 MODULATOR PUSH-PULL 807s

Line up same as MD-40 except 807 in output. Will deliver a conservative 100 watts of audio for the 200 watt r.f. transmitter. Complete as above with electro-voice 915 microphone. Only $44.95

BROADCAST MODULATION TRANSFORMER

R.C.A. 833'As to pair 833'As, as used in R.C.A. Commercial 1 K.W. Broadcast Transmitters. Transformer being used in U.S. Broadcast stations. New fully guaranteed. Primary 15,000 ohms Secondary 5,030 ohms. 86 KVA Audio. Size 12x10x13. Wt.—uncrated 153 lbs. Limited Qty. available $75.00

POWER TRANSFORMER

440-220 Volts AC

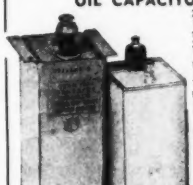
440/220 3 Phase. A husky brute for induction heating. Primary 440/220 3 phase. Secondary Each phase 1365V at .67 Amps. Manf. by Raytheon. This transformer and a pair of 304's will give 2.5 KW output at a total cost of less than $50.00. Special while they last. Only $42.50
440 or 220 1 phase Filament transformer, 440/220 Pri. Secondary 5.0 V at 20 Amp. 1500 volt insulation. Herm. Sealed Navy Specs. ..... $
Plate Transformer. 200/220/240 Pri. Secondary 1400V CT. at 350 ma. Gray Hermetically sealed $6.70
Filament Transformer 200/220/240 Pri. Secondary 6.3V at 2.7 Amps. Matched unit for above $2.45

POWER TRANSFORMERS

115V A.C. 60 cycles Primary

3700-0-3700 at 500 Ma. $59.00
2500-0-2500 at 700 Ma. 44.50
2500-0-2500 at 500 Ma. 39.50
740-0-740 at 1.2 Amps 17.50
550-0-550 at 200 Ma. 6.3V at 4A
6.3V at 4A
5.0V at 3A 7.50
425-0-425 at 150 Ma. 2.50
415-0-415 at 125 Ma. 2.25
375-0-375 at 400 Ma. 4.50
375-0-375 at 300 Ma. 3.50
300-0-300 at 150 Ma. & filaments 3.00

OIL CAPACITORS



2 MFD 5500 VDC Interleen $5.80
2 MFD 6000 V DC Interleen $6.50
1 MFD 7500 V Dc Interleen $5.80
1 MFD 5000 V DC 5069 ..... $3.95
.1 MFD 7000V D C 836B1170 ..... $1.95
.25 MFD 1000V D C 26F767 ..... $2.85
.15 MFD 6000V D C 26F386 ..... 2.10
.1 MFD 3600V DC 8412 ..... $3.10
10 MFD 1000V DC 22F47 ..... $2.45
4 MFD 1000V DC 21F252 ..... $4.15
10 MFD 600V DC A1000 ..... $1.25

SPECIAL

.005-.01 MFD 12KV 15F646 ..... $4.75
.02 MFD 20,000V BT 1761 ..... $5.95

FILTER CHOKES

Audio Reactor 1 Hy. 800 ma 15KVA Ins. Amertran—size 5½x8. Wt. 85 lbs. $7.50
10H 75ma/260 ohm herm. ..... .70
4-20H 100ma/120 ohm. herm. ..... .95
10H 100ma/280 ohm, herm. ..... .90
5H 150ma/100 ohm, herm. 1.20
10-14H 147 200 ma/100 ohm. 1.95
3H/200 ma 70 ohm. 1.95
5-3H/200 ma/60 ohm, herm. 2.50
6H 350ma/82 ohm. 4.50
12H 450ma/112 ohm, herm. 9.50
8H 500ma/80 ohm 8.50
5-20H 500ma/80 ohm 8.25
8H 700ma/60 ohm 12.75
5-20H 700ma/60 ohm 12.50
3H 275ma, 17H/175ma,17H/125 ma. 3.75
4H 85ma, 6H/90ma, 12H/65ma. 2.10

MULTI CONDUCTOR CABLE

MILLION FEET AVAILABLE

9 CONDUCTOR #20 str. plastic, 2 vinyl jacket. Shield ⅛" G.E. Reel Lengths .08/ft. 100 ft. .11/ft.
10 CONDUCTOR #20 Solid. Plastic vinyl jacket. ⅛" dia. On steel reels. Reel lengths .07/ft. 100 ft. .10/ft.
28 CONDUCTOR #30 stranded plastic vinyl jacket ¼" dia. Reel lengths. 20/ft. 100 ft. .24/ft.
4 CONDUCTOR. Each cond. ¾" dia. Std Double plastic Ins. Heavy Duty Power Cable. Extremely flexible. 1-¾" Dia. Reel lengths Approximately 250 ft. .26/ft.
3 CONDUCTOR #18. Shield Jacket. .05/ft.
2 CONDUCTOR #20 Shield Jacket. .04/ft.

COAXIAL CABLE

RG-77/U Federal ..... $.06/ft.
RG8/U Amphenol. 50 ft. lengths with SO-239 connectors on each end. $2.69
RG/58U ⅛" dia. ..... .12/ft.
RG/59U ¼" dia. ..... .12/ft.

WIRE

#20 HV str. white plastic $4.95/M
#20 str. white lacquer 3.50/M
#20 str. red lacquer 3.50/M
#20 str. green lacquer 3.50/M
3/16" magnet DCC rect ..... .35/lb
#20 SSE Magnet ..... .60/lb
¼" tin shield braid ..... .30/lb

RELAYS-CONTACTORS

Type	Coil Contacts	Price
CH contactor, 115V AC	4PST, 30A	7.95
West. MC gl. encl.	115V 4PST, 20A	7.50
Allied Bo.	5V DC DPDT 10A	.75
Advance min.	4500ohm 12V	1.95
SPST 5A		.60
G.E. PJC Adj.	Overload 4-12A ac	12.50
do		12.50
G.E. PJC Adj.	Overload 2-8A ac	12.50
do		12.50
G.E. PJC Adj.	Overload 0.5-1.5A ac	7.95
do		7.95

Regulated Power Supplies in Kit Form

Ruggedly constructed, conservatively rated and fully engineered.

Model 325A

Input 105-125V 60 cycles AC.
Output 200-325V DC continuous variable regulated. 6.3V at 3 Amps. at 100 MA.
Regulation better than 1% no load to full load. 1% input line variation. 105-125V.
Price complete with tubes $29.50

Model 325B

Same as above but for rack mounting $27.00

Model 500A

Input 150-125, 60 cycles AC.
Output 200-500V DC continuous variable regulated 200 MA.
Regulations better than 1% no load to full load. 1% input line variable 105-125V. In enclosed parmetal portable cabinet.
Price complete with tube and Instruction Manual $47.50

Model 500B

Same as above but for rack mounting $44.00

BAND PASS FILTER

750 and 1000 CPS

Band Pass at 3 db ± 150 cycles. Center Frequency adjustable ± 10 cycles. Input 23,000. Output 225,000 Triple alloy Shielded. Mfd. by UTC. Size 1¾x1¾x2". Specify Frequency.
$2.95 each

TELEVISION INTERFERENCE FILTERS

A New Lease on Ham Radio! TVI can be cured and Eldico's got the medicine. Here are filters that have been proven to work in ham transmitters literally buried under TV antennas. Just insert in series with the antenna and harmonic attenuation will exceed 60 db. Rest of all the cure won't even dent your budget. Here is the complete story:

- Two types—one for the rig (low-pass), one for the TV receiver (high-pass).
- Two models of each type—coax cable or Twinex.
- In kit form, complete in every detail. Simple assembly in 20 minutes.
- Transmitter filters good for power to 1 kw. Receiver filters efficient as any manufacturer's set.
- Insertion loss negligible. No effect on antenna performance.
- Amazingly low priced!

Transmitter Filters $4.59
Model TVT 62 Coax
Model TVT 300 Twinex
Receiver Filters $1.98
Model TVR 62 Coax
Model TVR 300 Twinex

Add 25c for postage and handling on all orders.

TRANSFORMERS

4500 Volts at 4.5 Ma. 5 V at 3 Amps.	$7.95
2750 Volts at 2 Ma.	4.50
1100 Volts at 10 Ma. & Filaments.	2.75

FILAMENT TRANSFORMERS

115V AC 60 cycles Primary

78 Volts at 11 Amperage	$3.50
36 Volts at 10 Amps.	5.95
24 Volts at 10 Amps.	4.95
11.5 Volts at 11.5 Amps. (10 Volts at 20 Amps.)	4.95
10 Volts at 6 Amps.	3.50
10 Volts at 6 Amps. 6.3V at 11A, 5.0V at 3A	5.50
5 Volts at 10 Amps. 15KV Ins (For 872A's)	5.75
2.5 Volts at 10 Amps. 10KV Ins. (For 866A's)	3.75

ALL MATERIAL NEW AND GUARANTEED

10% Discount on order over $100.00.
15% Discount over $500.00.
No Discount on Transmitters.
Large quantities available.
Quotes on request.

ELDICO OF NEW YORK, INC.

44-31 DOUGLASTON PKWAY., DOUGLASTON, L.I., N.Y., U.S.A. Cable Address. ELDICOINC

BAYSIDE 9-8686

TEST EQUIPMENT

X BAND SIGNAL GENERATOR. 8500-9600 mc, calibrated wavemeter and attenuator, for 110 V 60 cps operation.

SPECTRUM ANALYZER FOR X BAND. TSX-3SE, Sylvania, good working order, 110 V 60 cps.

TS-45A/APM-3 SIGNAL GENERATOR. 9200-9600 mc, 110 V 60-800 cps.

X BAND WAVEMETER CAVITY. TRANSMISSION TYPE. 9200-11000 mc..... $15.00

WAVEMETER CAVITY. 8500-9600 mc, TRANSMISSION TYPE..... $35.00

TS-155B/UP S BAND SIGNAL GENERATOR. pulsed, calibrated output, 110 v, 60 cy. NEW.

TS-155A/UP S BAND SIGNAL GENERATOR. pulsed calibrated output, 110 v, 60 cy. NEW.

SPECTRUM ANALYZER FOR S BAND. TSS-4SE, Sylvania, good working order, 110 V, 60 cps.

TPS-51PB/20. S BAND 20 db PAD..... $20.00

TGS-5BL S BAND SIGNAL GENERATOR. 2600-3400 mc, pulsed, calibrated output 110 V, 60 cps.

X BAND PICK-UP HORN..... $10.00

TS-62/AP ECHO BOX FOR X BAND

APR-1 RADAR SEARCH RECEIVER, complete with tuning units for range of 28-4000 mc, 30 mc I.F., 2 mc wide.

TUNING UNITS for **APR-1** or **APR-4 RECEIVERS** (can be used with any 30 mc amplifier):

TN-16, range 30-90 mc
TN-17, range 80-300 mc
TN-19, range 1000-2000mc
TN-54, range 2000-4000 mc

X BAND VSWR TEST SET TS-12/AP, complete with linear amplifier direct reading VSWR meter, slotted wave guide with gear drive traveling probe, matched termination and various adapters, with carrying case, NEW. UNIT I AND II are available separately, or together as a test set.

TA-16 VOLTAGE STANDING WAVE RATIO MEASURING AMPLIFIER similar to the amplifier of TS 12 AP Test Set)..... $180.00

S BAND SIGNAL GENERATOR CAVITY with cut-off attenuator. 2300-2950 mc, 2C40 tube, with modulator chassis..... $30.00

UPN-1 S BAND BEACON RECEIVER TRANSMITTER..... $75.00

S BAND TEST LOAD. TPS 55P/BT. 50 ohms $8.00

X BAND TEST LOAD. TS-108/AP. 150 watts accessories..... $35.00

LAE-2 SIGNAL GENERATOR. 220-1400 mc, CW & pulse modulation, calibrated output 110 V, 60 cps, used, good condition.

LAF-1 SIGNAL GENERATOR. 100-600 mc, CW & pulse modulation, calibrated output, good condition, 110 V, 60 cps operation.

GENERAL RADIO SIGNAL GENERATOR MODEL 522. 250-1000 mc, good operating condition.

GENERAL RADIO 804 B SIGNAL GENERATOR 7.5-330 mc, good working order..... $200.00

GENERAL RADIO POWER OUTPUT METER MODEL 583-A..... $45.00

GENERAL RADIO VACUUM TUBE VOLTMETER MODEL 726, good working order..... $120.00

GENERAL RADIO PRECISION WAVEMETER, type 724A, range 16 kc to 50 mc, 0.25% accuracy, V.T.V.M. resonance indicator, complete with accessories and carrying case, new $175.00

FEDERAL RADIO SIGNAL GENERATOR MODEL 804C, 7.5-330 mc, good operating condition.

MEASUREMENTS 78E. 50-75 mc, calibrated output..... $100.00

FERRIS MODEL 22A SIGNAL GENERATOR. 85 kc to 25 mc. Output .2 microvolts to 1 volt, modulation variable, good working order..... $175.00

FERRIS MODEL 10 B SIGNAL GENERATOR. 85 kc to 25 mc, calbrated output, good working order..... $100.00

LABORATORY RECTIFIER. Sylvania 541-A, 3500 volts at 2 amperes DC..... $60.00

LB-3 LIMIT BRIDGE, INDUSTRIAL PRODUCTS..... $60.00

P-4 SYNCHROSCOPES, made by Sylvania or Browning Lab..... $175.00

SIGNAL GENERATOR 1-72-K, 100 kc-32 mc, output not calibrated, 110 v, 60 cps..... $35.00

AUDIO OSCILLATOR. HICKOK 198, RC tuned, 20-20000 cps..... $45.00

TEST SET TS-278/AP FOR AN/APG-13, synchronized, delayed pulse signal generator, 400-450 mc, calibrated waveguide below cutoff attenuator, synchronized marker generator, 115 V, 60 cps. NEW, COMPLETE..... $160.00

TS-10/AP FOR APN-1..... $40.00

RCA SCOPE, 5" MODEL 160B, NEW, export packed..... $125.00

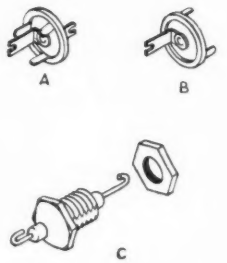
CLOUGH BRENGLE RESISTANCE CAPACITY BRIDGE, model 230A, new..... $50.00

FIXED ATTENUATOR PADS, 20 db + 0 — 2 db, DC—1200 mc, 50 ohms, VSWP 1.3 or less, 2 watts average power..... $30.00

MUTUAL INDUCTANCE ATTENUATOR. Calibrated: frequency range .1 to 1000 mc by means of plug-in coils, attenuation range 120 db $100.00

MUTUAL INDUCTANCE OR PISTON TYPE ATTENUATOR, type N connector's rack and pinion drive, attenuation variable 120 decibles, calibrated 20-120 db, frequency range 300-2000 mc..... $32.00

MUTUAL INDUCTANCE OR PISTON TYPE ATTENUATOR, similar to above, except upper frequency limit is 3300 mc..... $32.00



CERAMIC FEED-THRU CAPACITORS

Type A.....	300 mmf.....	10 for $2.00
Type B.....	300 mmf.....	10 for $2.00
Type C.....	55 mmf.....	10 for $1.00

TRANSFORMERS, 115 volts, 60 cps primaries:

1. 6250, 3250 and 2000 volts, tapped primary, voltage doubler, 12.5 kv ins.....$14.00
2. 6250 volts 80 ma, ungrounded, G.E. voltage doubler, 12.5 kv ins.....$12.00
3. 2 secondaries at 500 volts 5 amps each, wt 210 pounds $50.00

PULSE INPUT TRANSFORMER, permalloy core, 50 to 4000 ko impedance ratio 120 to 2350 ohms $3.00

PULSE TRANSFORMER. UTAH 9280.....$1.50

PULSE TRANSFORMER 132-AWP.....$6.00

PULSE TRANSFORMER. GE 68G, 828G-1. $5.00

PULSE TRANSFORMER. Westinghouse 145-EWP $10.00

PULSE TRANSFORMER G.E. TYPE K-2476, 1 microsecond pulse, 350 pps, 28.5 KV peak, impedance ratio 450/50 ohms.....$25.00

TRANSMITTING OIL-FILLED CAPACITORS:

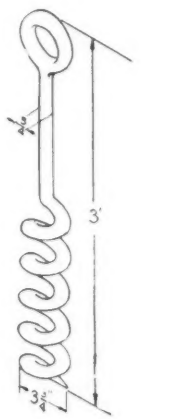
2 MFD 600 WVDC ROUND CAN ....10 for $2.
100 for $10.00

2 Mfd	1000 WV.....	1.00
1 mfd	2500 WV.....	1.50
.15 mfd	4000 WV.....	1.00
2Mfd	4000 WV.....	5.00
.1 — .1 mfd.....	7000 WV.....	2.00
.075 — .075 mfd....	8000 WV.....	2.00
1 mfd	15000 WV.....	25.00
.2 mfd	10000 WV.....	5.00

W. E. EQUALIZER D162118.....$5.00

HYPERSIL CORE CHOKE, 1 Henry, Westinghouse L-422031 or L-422032.....$3.00

PULSE FORMING NETWORK, 20 kv, .92 microsecond, 50 ohms, 800 p.p.s.....$40.00



ANCHOR SCREWS from AB26CR Mast Equipment .....$2.00 each

ELECTRO IMPULSE LABORATORY

P. O. Box 250 *Eatontown 3-0768* **Red Bank, N. J.**

Nobody but ARICO has: "hard-to-get" items— SPARE PARTS ARE HARD-TO-GET

RADAR AN/APS-2C or 2E

Spares including:

1 ea B-201 Blower Motor, 1 ea B-801 Blower Motor, 1 ea B-802 Blower Motor, 3 ea Crystal IN-21 and the following tubes: 3 ea 6AC7, 2 ea 6H6, 3 ea 6SN7, 3 ea 6L6GA, 2 ea 2AP1, 2 ea 5FP7, 2 ea VR-105-30, 2 ea 5U4G, 2 ea 6X5GT, 2 ea 2X2, 2 ea 829, 2 ea RKR72, 2 ea 715-B, 2 ea 2J-22, 2 ea 417-A, 2 ea 721-A, plus misc. fuses, brushes, valve core, dehydrator, etc. Brand new, packed in grey chest with description list.

$89.00 Complete Set

AN/ARC-5 or SCR-274-N

Spares incl:

53 ea. asst. tubes incl. 12SK7, 12K8, 12SF7, 12SR7, 12A6, 1235, VR-150, 1625, 1626, 1629, 24 ea. dyn. brushes, 25 ea. asst. capacitors, 8 ea. asst. tube clips, 5 ea. asst. chokes, 20 ea. fuses, 35 ea. asst. resistors and 4 ea. transformers. Brand new, packed in gray hardwood chest with tray, hasp, handles and complete parts catalog including part number and electrical ratings.

$29.00 Complete Set shipping wt. 35 lbs.

AIRCRAFT RADIO EQUIPMENT and TEST SETS

BC-221-AH Frequency Meter..... 85.00 ea
AN/ARM-1 Test Set for ARC-3.....150.00 set
A-27 Phantom Antenna..... 5.00 ea
A-58 Phantom Antenna 100 w, 200 kc—12 mc 15.00 ea
A-98 Phantom Antenna with special R-F Meter, for testing Gibson Girls..... 15.00 ea
I-100 Test Set for ARN-7 or 269 Compass 850.00 set
I-139 Test Motor for SCR-522..... 12.00 ea
IE-19 Test Set for SCR-522 complete....200.00 set
TS-10A/APN Altimeter Delay Line ..... 40.00 set
TS-16/APN Altimeter Test Set 24-v AN/APN-1 125.00 set
TS-16X/APN Altimeter Test 12-v AN/APN-1 150.00 set
TS-80/U Test Meter for AN/ARC-1.....12.00 ea
I-86 Test Set..... $95.00
RC-54 Test Set for ARC-5 or 274-N Receivers 150.00 set
RC-55 Test Set for ARC-5 or 274-N Transmitters 250.00 set
I-95 UHF Field Strength Ind. (100-150 MC) 35.00
R-111B/APR-5A REC. Like New ..... 150.00 ea
PP-29/CRN-2 Rectifier Power Supply for SCS-51 ILS Glide Path Xmittr. (used)..... 200.00 ea
W. E. Type 278 Marker Receivers 12-v (complete and reconditioned)..... 150.00 set
Bendix RTA-1B Transmitter only (recond. L. N.) 500.00 ea.

Some of the above Test Sets are one of a kind in stock.

Also in stock: AN/ARC-1, AN/ARC-3, AN/ART-13, BC-348, AN/ARN-7, MN-26, SCR-269-G.

LOWEST PRICE TUBE LIST

2 API	$ 3.00	12B7/14A7	.60	829	3.00
2 x 2	.69	1215-GT	.40	955	.35
2J22	8.50	12K8	.60	1625	.35
2 x 2A	.95	12SF7	.59	1626	.35
5FP7	1.25	12SK7	.60	1629	.20
5U4G	.65	12SH7	.35	2050	.70
6AC7	.79	12SN7	.75	2051	.70
6AG5	.75	12SR7	.40	9001	.39
6AK5	.90	14B6	.50	9002	.39
6AQ7	1.25	28D7	.40	9003	.39
6E5	.75	35Y4	.65	9004	.39
6H6	.50	RKR-72	1.50	9006	.39
6L6GA	.75	417A	14.95	VT-25	.35
6SL7GT	.79	715-B	7.50	VT-52	.35
6SN7GT	.79	717-A	.85	NE-16 (991)	
6V6GT	.75	721-A	3.50		.29
6X5GT	.65	826	.50	NE-48	.20
12A6	.25	811	2.25		

LARGEST DYNAMOTOR LIST AT LOWEST PRICES

DM-32 (24V)	$ 2.00	DM-18 (MN-26 12V)	10.00
DY-2/ARR-1 (24V)	3.00	DY-21/ARC-3	10.00
DM-32-AZ (12V)...	12.00	DY-22/ARC-3	7.00
DM-33 (24V)	5.00	DM-53-A (24V) ea.	5.00
DY-8/ARC-5 (24V)	5.00	DM-53-AZ (12V) ea.	12.00
DM-28 w/flt	3.50	PE-86 w/flt (24V)	3.00
DM-28 less flt	3.00	PE-86-AZ w/flt (12V)	12.00
DM-24 w/flt (12V)	10.00	DY-12/ART-13 w/flt	35.00
DM-24 less flt	8.000	DY-12/ART-13 l/flt	15.00
PE-73 (24V)	10.00	BD-77 (12V)	10.00
D-101 (APN-24V) ea.	5.00	PE-109 Inverter (12V)	50.00
D-101 (APN-1 12V)	10.00	MG-149-H Inverter (24V)	39.00
PE-94-C (522 24V)	5.00	ZA Dyn. for 12V R-89 Rec.	5.00
PE-98 (522 12V)	20.00		
DA-7A (Bendix TA-2J)	25.00		
DA-1A (MN-26 24V)	10.00		
DA-1B (MN-26 12V)	10.00		

ABOVE MATERIAL ALL BRAND NEW IN MANUFACTURERS ORIGINAL BOXES. DELIVERY STOCK, SUBJECT TO OMISSIONS, CORRECTIONS, PRIOR SALE.

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The Best in Electronic Surplus!

RADIO TRANSMITTERS, MODULATORS, AND POWER SUPPLIES

Immediate Delivery from Stock

2.5 KW Press Wireless. Model 2.5 consisting of 2 sections, one—the 2.5 KW P.A. with power supply, second section containing exciter-driver stages with crystal-controlled oscillator (with oven for constant temperature control). Emission A1. Freq. range 2 to 23 mc. Operates from 220 V.A.C. Excellent condition. Less Tubes. $3,000.00

BC-319-A Transmitter. CW only 300 watts output Freq. range 4.0 to 13.4 mc. Operates from 110-220 volts, 60 cycles AC. Excellent condition. Less tubes. **PRICE EACH** $300.00

Wilcox, 96-200A 2-KW RF section. Large cabinet with complete RF end containing the VFO, intermediate sections and PA stage. Almost new, but lacks PA inductance only. Less tubes. **PRICE** $300.00

TBK-10, 500 W., 2-18.1 MC. CW Telegraph Transmitter designed for ship installation. Almost new condition, complete with tubes, but less MG set and accessories. **PRICE, EACH** $350.00

WILCOX 98A Ground Station. A 3 emission 50 to 200 mc, 50 W. output, 4 channels dial telephone selection, with receiver for above frequency coverage, and remote control unit. For 110 volts AC. Excellent condition. With tubes. **PRICE, EACH** $600.00

LINK FM Transmitter-Receiver, 70-100 MC. 50 Watts Output. Model 149S DC. Wall style cabinet containing transmitter, receiver and 14 V.D.C. power supply, handset. Dim.: 54"x21"x11". NEW CONDITION. Complete with tubes, crystals, special telescopic antenna, instruction book. 50 W. output. **PRICE EACH** $500.00

MODEL SVC100L/110 TRANSMITTER. Output A1 150 watts, A2 A3 50 W. Mfd. by Philips. Freq. 2 to 20 mcs., with 6 pretuned channels. Operates from 90 260 volts 50/60 cy. A.C. **COMPLETE,** with tubes $450.00

BC-1100 (BC 265). 75W. A1, 50W. **A3, 4** channel dial selection of channel. 1.5-10 mcs. 110-260V 25-60c. AC., with remote control. New. **EACH** $575.00

Supreme ship-to-shore transmitter receiver. 110W output, 9 channel, 2-3 mcs., crystal controlled for 110V. 60c. A.C. Condition N 2. Complete with tubes and microphone. **EACH** $500.00

NORTHERN RADIO Ship-to-Shore Radio Telephones. 5 Channels 2-3 mc crystal-controlled. 65 Watts Output. Power Supply operates on 110 V. D.C. **COMPLETE** with tubes. Excellent condition. **EACH** $250.00

DZ-2 DIRECTION-FINDING EQUIPMENT, with loop assembly. 28 V. DC operation. 15-70 & 100-1500 Kcs. NEW. **PRICE, EACH** $150.00

SCR-511 "POGO STICK" WALKY-TALKY. Portable low power AM radiotelephone for 2 to 6 mc operation, with 12 plug-in tuning coils, tuning crystals for crystal control of both receiver and transmitter. Any one plug-in coil provides instant changeover between any two frequency channels. Transmitter receiver BC-745 of this SCR-511 includes telescopic antenna and "Press-Talk" Switch as well as all cables. Range 5 miles, plus. With PE-157 2-volt storage battery operated Vibrator Power Supply, 2-Volt Battery (less electrolyte), 7-15 miles all ready for immediate operation. NEW. **PRICE, EACH** $85.00

32 VOLT DC to AC ROTARY CONVERTER, mfd. by Kato. For yachts, workboats, or farm installation. Output 110 V., 60 cycles AC, rated 225 watt but good to 300 watts. All NEW units. **PRICE, EACH** $39.95

DECK ENTRANCE INSULATORS, bowl and flange type, 8⅝" dia. with heavy galvanized metal flange and bell. Top bell 8¼" dia. 11½" brass feed-thru rod. Very high voltage insulation. Individually packed in cartons, all NEW. **TEN FOR** $15.00

GENERAL ELECTRIC AMPLIDYNE M.G. SET, generator type 2V-587567, motor type 2?3AR58, Navy #CG-21ARU, 115-230V, 60c. motor rated at ¾ HP., generator output 250V. DC at 375W. NEW. $60.00

GENERAL ELECTRIC AMPLIDYNE MODEL 5AM79AB47 GENERATOR SET. EACH $12.00
Motor 3HP 440V, 3 phase. Output 250V. DC at 3 amps. and 60V. DC at 12.5 amps. Excellent Condition. $85.00

"SNOOPERSCOPE" TUBE

Infra Red Image Converter Tube (British) to make "Snooperscopes," "Sniperscopes," and other devices that see in the dark. Operates with invisible infra-red rays, without scanning or amplifiers. See October Radio Electronics for interesting constructional article. Supplied with technical data and diagrams. Every tube guaranteed!
PRICE, EACH ..... $ 8.00
TWO FOR 15.00

BAUSCH & LOMB Front End Lens Assembly, for 8mm images. F2.1, 2.5 in. E.F. **EACH** $12.00

MOUNTED LENS UNIT, also for front-end, results as good as B & L unit. Speed F1.9, f.l. 91.44 mm, outside dia. at one end 60 mm, length of mount 64 mm. **PRICE, EACH** $9.90

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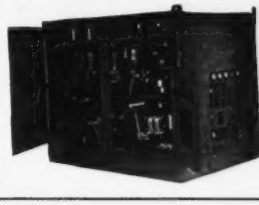
WORTHWHILE SAVINGS TO YOU:

INDUSTRIAL POWER SUPPLY EQUIPMENT

T-102 — Filament Transformer. American Transformer Co. Spec. 29106. Type WS .050 KVA. 50/60 cyc. Single phase, 35 KVA test, 12 KV. D.C. operating. Primary 115 V., secondary 5 V., 10 amps with integral standoff insulator and socket for 250 T, 371, 872 and 5563, etc. rectifier tubes. **$12.50** Net Wt 15⅝ lbs. Dim. 6½" W x 6" D x 12" H.O.A.

NEW RA-38 RECTIFIERS

115 v., 60 cy. 1 phase input, output 0-15,000 v. d-c @ 500 ma. Write for detailed information.



MOTOR GENERATORS AND PUMPS

G.E. type CC-21991: Input 115 v d-c @ 5.7 amps. Output 115 v a-c 60 cyc. single phase, 550 va @ 85% P.F. $58.00
G.E. type CC-21990: Input 32 v d-c @ 22 amps. Output 115 v a-c 60 cyc. single phase, 2550 va @ 85% P.F. $63.00
Portable Vacuum Pump Assembly: Leland 110/220 v 60 c. 1 phase 1 h.p. motor with 8 CFM automatic oiler; mounted on tubular steel frame $86.00

TUBE STOCK CLOSEOUT

DISCOUNTS **20% on orders over 100.00**
30% on orders over 500.00

( ) Indicates stock on hand. Subject to prior sale & limited to present stock.

NEW CAPACITORS

2 mfd. 600 v. d-c tubular. **$.30;** 10 for $2.50; $20.00 per C
2.5/5 mfd 1,000 v. d-c. **$.90;** 4 for $3.00
3 x 1.0 mfd 1,200 v. d-c wk; isolated sections $1.20
1.25 1.25 mfd 7.5 kv d-c or .625 mfd 15 kv d-c; Standard Brand $12.50
.25 .25 mfd 7.5 kv d-c or .125 mfd 12 kv d-c $1.75
1.0 mfd 25 kv d-c; Standard Brand. $38.00
500 mfd 200 wv d-c electrolytic; insulated terminals ..... .95
.001 mfd 25 kv d-c mica; 25 A @ 3,000 kc, 18 A. @ 1,000 kc, 11A. @ 200 kc $25.00
50 mmfd 32 kv d-c tubular vacuum $4.95
9.12 mfd 1265 v. a-c, 4000 v d-c. New; Standard Brand $17.00

METERS

Weston or Westinghouse

3" 0-120 a-c amps. w/current transf. $8.50
3" 0-20 kv d-c w precision multiplier. 18.00
3" 0-4 kv d-c w precision multiplier. 9.50

SPECIALS

Westinghouse Meter Multiplier: Type R-5 1 mcs., ½% tol., w.w. noninductive $1.25
Filament Transformer: Constant current; 110-220 v., 50/60 c; sec. 21.5 v 40.5 A. $17.50
Tube WL 386/ML-2W; 125 KV X-ray oil immersion test. 10 v 11.6 A fil. **$12.00**
CRAMER Time Delay Relay: TD12 120S; 0-120 sec., 115 v, 60 c., syn. motor-driven; 10 A., 115 v., S.P.N.O. contacts $14.95
Motor: 27 v. d-c, 0.7 A., 110 R.P.M., 1 oz./ft. torque $3.50
Solenoids: 115 v., 60 c; continuous, net 2¼ lbs. $2.75
Intermittent, wt. 9 lbs. $2.75
Indicator: 1-31-A Radio Compass. New $3.85
Indicator: 1D-14/APN-1 Radio Altimeter. $4.50
Loop: MN-20E, for MN26 direction finder. New $10.00
Computer: CP-14/APS-15A. New.. $10.00

All Tubes are New, of Standard Mfg., in original boxes.

Type	Price
1B22 (10)	$4.25
1B23 (10)	4.75
2162 (50)	37.50
3B22 (17S)	2.50
3B24 (15)	1.50
3C23 (300)	2.25
4B28/5259414	
6 A. Rectigon (450)	2.75
15E (200)	1.25
250TL (6)	19.50
304TL 115 v. 60 c. HV filament transformer & socket (40)	7.50
307A/RK75 (40)	3.75
316A (30)	.35
388A (30)	2.75
450TH (4)	22.50
700A (2)	9.75
701A (7)	3.50
702A (25)	2.75
703A (125)	2.75
704A (5)	1.00
705A (30)	1.00
706BY (6)	12.50
706EY (4)	12.50
707A (20)	12.50
707B (75)	7.50
708A (7)	2.75
713A (15)	.75
714AY (200)	3.75
715A (15)	7.50
717A (10)	.50
719A (10)	9.50
721A (1)	2.75
722A (15)	7.50
725A (7)	8.50
730A (9)	10.50
811 (7)	1.50
830B (5)	3.25
846 (2)	47.50
872A (300)	1.75
921 (40)	1.25
931A (300)	2.50
C5B (20)	7.75
C6A (40)	8.25
C6J (50)	4.75
FG81A (200)	3.75
WE-203A (4)	8.75
VT98(Br.) (30)	12.50

TRANSTATS

115 v. 50/60 c; 0-130 v. 10 amp. output $24.50
115 v. 60 c; 103-126 v. 2.17 amp output $9.50
115/230 v. 50/60 c; 0-260 v. 2.5 amp output $21.50

TRANSFORMERS

115 v. 60c. primaries
Amertran: 17,600 v @ 10.4 K.V.A. cont. $65.00
Amertran: 8,800-0-8,800 v @ 10.4 K. V. A. cont. $75.00
Westinghouse: 18,400-0-18,400 v @ 9 K. V. A., cont., plus 2 WL-531 rect. tubes, fil. transf. & 50 h. 575 ma. choke $160.00
24 v. @ 1 amp. uncased $1.60

RELAYS

Westinghouse Type SC-M Overcurrent relay, 2 to 1 A., .8 A. cont. rating 20-40% drop out ratio. $12.95
A-B 810 Overload Relay. 6.3-18.1 A., 600 v. max. $7.95

CHOKES

Amertran: Swinging, 900 h @ 16 ma. 25 h @ 525 ma. 35,000 v test. $42.00
Kenyon: 20 h @ 30 ma. 15,000 v test $12.00

CONTACTORS

I.T.E.: 115 v, 60 c. coil, Single pole 115 A., 600 v. with barriers, adj. time delay & remote contact control trip $10.95
A.B #RC-3301: 115 v. 60 c. coil D.P.S.T. 15 amp contactor. $4.95
Monitor: 115 v. 60 c. coil N.O.D.P. contactor, 100 A. 600 v. N. C. 15... 600 v. 1.0A. contact, One N. O. & one N. C. interlock w/150 A & 30A. renewable fuses $8.95

RESISTORS

200 watt wire wound resistors, ferrule ends- 160,000 ohm, 5,000 ohm, or 1,000 ohm $1.00

CONSTANT VOLTAGE TRANSFORMERS

95 to 125 volt 50 cycle single phase input: 115 volt output:
60 va $8.40
120 va 13.20
190 to 250 volt input: 220 volt output. 60 va $8.40

RAYTHEON
198 to 242 volts 50/60 cycle single phase input: 220 volt 500 watt output. $38.00

ASD RADAR TRANSMITTER & MODULATOR

3 centimeter: complete with 725A magnetron, cavity, two 723A/B Klystrons, one RK873, four 73's, one 715B, one 829B, two 724B's, two 6AC7's, one 1N21 crystal diode, high voltage supply, two cooling blowers, etc. Input: 115 v 400 c. N 2 condition. $110.00
Preamp assembly: includes plumbing (2) 723 A/B's, (2) 6AC7's, (2) 724B's, 1N23, etc. $37.50
725A Magnetron w/magnet $12.50

All merchandise in "as new" condition. Add approx. 20% to net weights for estimated shipping weights. Terms are 30% with order, balance C. O. D. All prices f.o.b. Los Angeles Warehouse. Write for additional detail information on any of the above items and for special quantity discounts. Telephone MAdison 6-5391.

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CREDIT TO ALL:

no deposit required on any orders and no COD's. If you like "my" material mail me your check within 10 days, if not—return the same for full credit

[redacted] NO RISK TO YOU!

ALL MATERIAL OFFERED BRAND NEW: this is only a partial list, and I have much more in my own stock at 360 Tremont Street, Boston, Mass.

HAYDON synchronous motor No. 60246B 110 Volt 7½ RPM with V3-14 Microswitch attached **6.85** each. In lots of 20 pcs. **5.25** each

WESTINGHOUSE TOTAL HOUR METER type RH-35 120 Volt 60 cycles up to 99,999.9 hours **8.50** each. In lots of 20 pcs. **7.25**

HI-VACUUM CONDENSERS Standard Brands in original individ. boxes. VC25 30KV **3.95** each. VC50 30KV **4.95** each. 1L24 100 muF 16KV **6.95** each

ATTENUATOR, Bridged T type, made by Tech Laboratories, Inc. type P 800 in 20 steps @ 2DB per step two hole mounting 3" round shaft 100 000 ohm **7.95** each. 250 000 ohm **9.95** each

POWER RHEOSTATS Standard Brands many sizes: PR50B 15 ohm **.59** each PR25B 500 ohm **.59** each

THERMISTOR and VARISTORS: type D169604 **2.89** each. Type D162181 **2.89** each

CRYSTALL-DIODES SYLVANIA JAN., individually boxed type 1N21B **1.49** each. Type 1N23B **2.95** each

RESISTORS: from 10 to 22 megohm (for each value)

10% tolerance	1-99 pc.	in lots of 100 or more:
½ watt	**.06** each	**4.00** p/hundred
1 watt	**.08** each	**6.00** p/hundred
2 watt	**.15** each	**9.00** p/hundred

for 5% tolerance ADD 100% to the above prices
Manufacturers' names supplied upon request.

POTENTIOMETERS in all ohmages single units **.50** for each—dual **1.25** each. Manufacturers' names supplied upon request.

BIRTCHER TUBE CLAMPS type 926B **.10** each or **8.00** per hundred. Type 926C **.10** each or **8.00** per hundred

COUPLING, FLEXIBLE, UNIVERSAL with ¼" x ¼" shaft holes and 4 setscrews: Cardwell type 5000A **.20** each or **15.00** p/C

OIL FILLED CAPACITORS Standard Brands (no return on these items acceptable, as the freight charges are too high)

	9MFD	600VAC	**2.85** each
	8MFD	600VDC	**.95** each
	4MFD	600VDC	**.75** each
TJ10080	8MFD	1000VDC	**2.25** each
KGC6080	8MFD	660VAC	**4.75** each
TJ40040B	4MFD	4000VDC	**7.85** each
	12MFD	660VAC	**6.45** each
TDF10010	1MFD	1000VDC	**.45** each
SD-210M	.02MFD	110VAC	**.35** each

TUBES: individually boxed, brand new:

6C4	Nat. Union	**.20** each	**18.00** p/C
1G6GT/G	RCA	**.38** each	**32.00** p/C
3B24	JAN	**1.85** each	**160.00** p/C
807	GE	**1.20** each	**100.00** p/C
872A	Westinghouse	**2.70** each	**240.00** p/C
813	Westinghouse	**6.85** each	
4B31	Raytheon	**28.50** each (only a few left)	

phone: **Boston, Mass. HANckok 6-4794**

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360 TREMONT ST
BOSTON, MASS.

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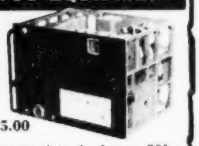
*But Boston's famous RADIO SHACK has 'em! We also have things that aren't so scarce, BUT . . . our lower prices are the reason you should CHECK WITH THE RADIO SHACK before buying elsewhere. Inquiries answered promptly!

COLLINS TCS EQUIPMENT

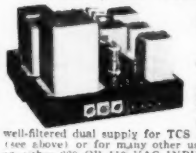
MODEL 51-Q RECEIVER
Only $49.50



Worth over $175.00

. . . beautifully constructed in the famous COLLINS communications manner. Perfect replacement for your SHIPBOARD or SHORE RADIO station, also for HAM communications receiver. Seven tubes — 3 — 12SK7, 2 — 12A6, 12SQ7, 12SA7. Precision tuning in 4 ranges, 1.5 mc to 12 mc. CW pitch control; separate RF and audio gain controls; slug-tuned i.f.'s. Input 12 VDC. Overall 13½x10x10". Weight 30 lbs. COMPLETE with tubes (uses external power supply). BRAND NEW, and the supply is LIMITED.

AC XMTR/RCVR POWER SUPPLY



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Built by COLLINS, meaning "built like a battleship". A well-filtered dual supply for TCS xmtrs and revrs (see above) or for many other uses. Can be used on either 220 OR 110 VAC INPUT! Output supplies 500 V @ 250 mils for xmtrs, and 225 V @ 100 mils for revrs. Complete with 4 rectifier tubes — 2 — 5R4GY, 2 — 6X5GT. Relay controlled. Overall 17x16x16. Weight 100 lbs. BRAND NEW IN ORIGINAL PACKING.

Western Electric
Precision Pot D-169099.
Worth $75. Only $12.50

Ideal for experimental and lab use. Precision construction, highly engineered 4-circuit motor or hand operated unit. Made up of 4 individual resistances: 6K, 13K, 13K and 16K. Two windings 180 degrees in respect to other pair. Continuous rotation. In black closed die-cast aluminum alloy frame (back can be unscrewed showing operation). Lug type connections on front. Panel mounting 1" shaft. Size 1½" long by 4½" diameter. BRAND NEW. WORTH AT LEAST $75. ONLY $12.50 EACH!

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LIGHTHOUSE		**PULSE**	
2B22 (GL559)	3.75	**(MODULATORS)**	
2C40	2.50	6C21 (450TH)	24.95
2C44	1.75	5D21	33.50
2C48	6.85	715A	8.95
446A	2.50	715B	9.95
TR TUBES		8011	2.95
1B23	5.00	8014A	22.95
1B27	7.00	**KLYSTRONS**	
1B32/532A	2.95	2K33	150.00
721A	3.90	WL417A	24.00
724A	4.75	707A	19.95
724B	1.70	707B	19.95
IGNITRONS		723A	7.95
WL651/656	30.00	723AB	10.95
WL653B	75.00	726A	19.95
WL681/686	15.95	726B	19.95

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L & N MICROMAX MODELS

REBUILT, RECONDITIONED ADJUSTED ELECTRICALLY AND MECHANICALLY

Single Point, Curve Drawing, Continuous Line, One set HIGH, COMMON, LOW Contacts. 110V AC Motor.

RANGES:

0—1200°F C/A	1000—2000°F C/A
0—1500°F C/A	1000—3000°F Plat./
0—1800°F C/A	10%R

PRICE $210.00

L & N MICROMAX MODEL R

REBUILT, RECONDITIONED ADJUSTED ELECTRICALLY AND MECHANICALLY

Single Point, Curve Drawing, Continuous Line. Chart speed—1 RPM/24 hrs. 1 set H.C.L. Contacts. 110V AC Motor.

RANGES:

700-1400°F C/A	**PRICE**
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1000-2400°F C/A	

STEP DOWN TRANSFORMERS SPECIAL

Made by GE, heavy duty, considerable overdesign, open frame, ideal for rectifier application, size: 3⅛" x 3⅛" x 4".
PRI—115 Volts 60 Cycles
SEC—15 V at 12 Amps **$3.75**

GE TRANSFORMER TYPE M Cat. 61G5

ISOLATION TYPE PRI.—230 V. SEC. 115 V
60 Cycles 250 Watts, 8" x 5" x 4½" **NEW—$6.50**
Net weight—14 lbs.

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Model RSA Type 12
Input—12V DC. Output—110V AC. 50/60 cycles. 125 W Intermittent, 100 W Cont. 8½"x8"x4½"—Net 15 lbs.
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DC Portables.....½ of 1% Accuracy
High Sensitivity, Moulded bakelite case

0- 20 Mics	260 ohms		127.87
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0-100 Mics	37 ohms		115.50
0-1.5/3/7.5/15/30/75/150/300/750 Volts			142.11

QUANTITIES LIMITED! ACT NOW!

WESTON MODEL 155—NEW!

AC PORTABLES...½ of 1% Accuracy
Hand calibrated mirror scale, black walnut case, leather handle

0- 50 MA	41.25	0- 1 Amp	28.87
0-100 MA	41.25	0- 3 Amp	28.87
0-250 MA	41.25	0- 10 Amp	28.87
0-500 MA	41.25	0- 25 Amp	32.17
		0- 50 Amp	33.33
0-150 Amp FS 5A			28.87
0-300 Amp FS 5A			28.87
0-300 Amp FS			28.87
0-150 Volts			31.76
0-300 Volts			32.17

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HIGH VOLTAGE CAPACITORS

1 MFD 20 KV DC 18"x13½"x25"	$25.00
1 MFD 25 KV DC-13"x7"x4"	9.85
.001 MFD 50 KV DC-5½"x7¾"x4" insulators 4" dia. x 7" high	12.50

Cap Mfd.	Volts D.C.	Height	Width	Length	Price
10	1000	5-7/8 x	1-3/4 x	3-7/8"	$1.85
4	1000	5-7/8 x	2-3/4 x	1-1/4"	.85
1	1000	3-5/7 x	2 x	1-1/16"	.50
½	500	2" x	1-1/4" x	1-1/16"	.25
25	1000	1-1/2 x	1" x	3/4"	.25

RACK PANEL CABINET

42" H x 22" W x 16½" D
Heavy Gauge Metal, Black Wrinkle Finish, shipped knocked down, ready to assemble with rear door and hardware. Front Panel not included. Panel size 19⅛" x 36¾". Shipping weight 99 lbs.
NEW! A REAL BUY.....$17.50

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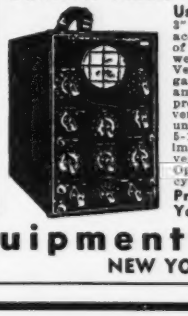
WESTON MODEL 271 Microammeter

Another of the famous Weston fan shaped line. Very large scale 5.8" long. These meters were made by Weston to General Radio specifications, with special mirrored scale and knife edge pointer. Accuracy 1%.
0-600 Microamps
170 M.V.
Coil Res: 250 Ohms
Your Price $22.50

WHSE PORTABLE GALVANOMETER

Type PX-12, Movement 7 MA, special scale, solid connecting terminals, contains a 1 Volt internal cell which can be easily removed for conversion to DC AMMETERS & VOLTMETERS. with leather case and canvas carrying strap.
A BUY AT $4.95

DUMONT Model 164-E 'SCOPE



Used! Guaranteed
3" CRT operates at acceleratingpotential of 1100 V—brilliant well - defined trace Vert amp voltage gain approx 43, horz amp voltage gain approx 55, Freq. range vert. & hor. amp both uniform ±3 DB from 5-100,000 CPS Input Impedance 1 megohm vert, .8 megohm hor. Operates 115 V, 40-60 cycle.
Price New $115.00
Your Cost $77.50

POWERTRON Electrical Equipment Co.

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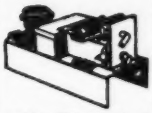
GUARANTEED GOVT SURPLUS



420—750 MC OSCILLATOR

Compact, beautifully built line oscillator employing two W.E. 368AS (703A) "doorknob" tubes in push-pull. Exceptionally stable. 5W output at 420mc, 2W at 700mc. Independent grid and plate tuning. Adjustable output coupling and tuning assembly. Coaxial output connection. Built-in blower may be operated from 110VAC. Power requirements: 300VDC/150ma, 1.2V/4A, 1.2V/4A. 5¼"x6¾"x11⅛". 7 lb. Supplied complete with tubes. Ideal for 420mc amateur operation or for use in the 460-470mc citizens radio band. **Stock No. APO-66.....$8.95**
Spare 368AS/703A tubes.....**$1.69 ea.**

JAN TUBES

BRAND NEW IN ORIGINAL CARTONS
*(Except as specified with *)*

1B24	$4.75	RKR-73	$9.95	954	$0.39
2C44	1.75	304TH	3.95	955	.39
2D21	1.19	304TL	1.95	956	.49
2J38	14.95	417A	19.95	957	.39
2J48	14.95	705A	1.95	958A	.39
2K28	24.95	715B	9.95	959	.39
2X2A	0.89	715C	24.95	991/NE16	.29
3D21A	1.95	723A/B	14.95	2050	.79
5R4GY	1.09	724B	4.75	8013	1.49
6AC7*	.79	725A	7.50	9001	.39
6AG7	1.19	805	3.95	9002	.39
6AK5	1.09	811	1.95	9003	.39
6AL5	.75	814	3.95	9004	.39
6J6	.95	815	1.95	9006	.39
6SL7GT	.69	829B	4.75	OB3/VR90	.89
6SU7GT/Y	1.29	872A	1.69	OC3/VR105	.89
6Y6G	.88	902A	3.95	OD3/VR150	.69
72/3B24	.95	931A*	3.95		

Specify JAN tubes when ordering.
** Manufacturers bulk pack JAN.*

Wide Range Butterfly Wavemeter & Oscillator Elements

Precision wide range butterfly circuit elements. Sturdily constructed. Mounted in ball bearings. Suitable for motor drive. Ideal for use as wavemeters and oscillators (See description below.)

Stock No.	Freq. (mc.)	Notes*	Unit Price
TN-20	105-330	1, 3	$4.95
TN2A	75-300	1, 4	4.95
TN-30	155-485	2, 3	5.95
TN3A	300-1000	2, 5	6.95

Brand new, in original packing.

* NOTES: 1) Aluminum construction
2) Silver-plated brass
3) Designed as oscillator element (955 acorn triode)
4) Has diode socket mounted on unit (955 as diode)
5) Has crystal diode mount for 1N21 crystal

WE CARRY A LARGE AND VARIED INVENTORY WHICH INCLUDES:

- AMPLIFIERS
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- WAVEMETERS
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Immediate delivery from stock (subj. to prior sale). Open acct. to rated organizations, others 20% with order balance COD. Prices FOB Corona, N. Y. and subject to change without notice.

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BRAND NEW U. S. GOV'T. SURPLUS GUARANTEED

ALLEN-BRADLEY CONTROLS

TYPE "J"

ohms	shaft	bush.	ohms	shaft	bush.
50	5/8"	1/2"†	10K	1/8"*	1/2"†
60	1/8"*	1/2"†	10K	3/8"	3/8"
60	5/8"	1/2"†	11K	1/4"	1/8"
100	5/8"	1/2"†	12K	3/8"	3/8"
100	1/8"*	1/2"†	15K	1-1/8	3/8"
150	1/8"*	3/8"	15K	1/8"*	1/4"
300	3/8"	1/4"	16K	1/4"	1/4"
400	1/8"*	1/2"†	20K	1/8"*	1/2"†
500	1/8"*	1/2"†	20K	3/8"	3/8"
500	1/2"	1/2"	22K	1/8"*	1/2"†
500	3/8"	1/4"	25K	1/8"*	1/2"†
600	1/2"	1/2"	30K	1/4"	3/8"
600	1/8"*	1/2"†	50K	1/8"*	1/2"†
1000	1/8"*	1/2"†	50K	3/8"	3/8"
1000	1/8"*	1/2"†	75K	5/16"	7/16"
1200	1/4"*	1/4"	80K	1/2"	1/4"
1500	1/4"*	1/4"	100K	1/8"*	1/2"†
1500	1/8"*	1/2"†	100K	9/16"	3/8"
2000	1/8"*	3/8"	150K	1/8"*	1/2"†
2100	1/8"*	1/2"†	200K	1/8"*	1/2"†
2200	1/8"*	3/8"	200K	3/8"	3/8"
2500	1/8"*	3/8"	250K	1/8"*	1/2"†
4000	1-1/8	3/8"	250K	7/16"	1/2"†
4700	3/8"*	1/2"	300K	1/8"*	1/2"†
5000	5/8"	1/2"†	350K	1/8"*	1/2"†
5000	1/2"	1/4"	1meg	1/8"*	1/2"†
5000	1/8"*	1/2"†	1meg	1/8"*	1/2"†
6500	1/8"*	1/4"	4meg	1/2"	3/8"

50c each

TYPE "JJ" DUALS

ohms	shaft	ohms	shaft
100 100	1/8"*	130K 130K	1/4"*
200 200	1/2"	150K 150K	3/8"
500 500	1/8"*	200K 200K	3/8"
500 500	2-1/8	250K 250K	1/2"
600 600	1-1/2	300K 300K	1/2"
2K 2K	1/8"*	350K 5K	3/8"
5K 5K	2-1/8	350K 25K	5/16"
10K 10K	3/8"	500K 8K	1/2"
20K 2K	3/8"	500K 500K	3/8"*
25K 10K	2-3/4	560K 560K	1/2"
35K 5K	3/8"	700K 700K	1/2"
40K 2K	3/8"	800K 75K	1/2"
50K 50K	1-1/4	1meg 1meg	3/8"
100K 100K	1/8"*	4meg 4meg	3/8"
100K 100K	1/2"	5meg 5meg	1/2"

$1.25 each

TYPE "JJJ" TRIPLES

ohms	shaft
20K 200K 15K	3/8"
20K 200K 20K	3/8"
45K 27K 2500	1/4"
700K 700K 700K	3/8"
750K 750K 750K	1-3/8"
800K 800K 800K	1-3/8"
1meg 1meg 1meg	3/4"

$1.95 each

*Screwdriver slot.
†Locking bushing.

OIL CONDENSERS

Mfd.	Volt.	Each
.1	3000	$0.75
.25	2000	.95
.25	3000	1.10
.25	3500	1.15
1	500	.28
1	600	.35
2	400	.35
2	600	.39
4	600	.59
6	400	.75
6	600	.79
10	600	.98
14	600	1.75
15	600	1.98
15	1000	2.75
30	900 AC	3.95
	3 Phase	
3x4	400	1.49
	Plug-in	

SPECIAL WHILE THEY LAST

PL-55
Lock-in Type
28¢
lots of 100
lots of 1000—25¢
less than 100—35¢

BATHTUBS

Mfd	200V	400V	600V
.033		17¢	
.05	17¢	19¢	21¢
.1	18¢	20¢	22¢
.15			22¢
.25	19¢	21¢	23¢
.35		22¢	
.5	20¢	23¢	25¢
.75			30¢
1.0	29¢	32¢	35¢
2.0		44¢	49¢

4/450V	35¢	2x05 1500V	35¢
8/500V	50¢	2x.1 600V	28¢
16/450V	55¢	2x.25 600V	30¢
25/25V	27¢	2x.5 600V	35¢
25/50V	28¢	2x1 600V	59¢
25/75V	30¢	2x200 9V	49¢
40/25V	27¢	3x.05 600V	40¢
50/25V	28¢	3x.1 600V	45¢
200/12V	25¢	3x.25 600V	50¢
300/6V	35¢	3x1/100V	40¢

POWER RHEOSTATS

(nationally known mfrs)

ohms	watt	ea.	ohms	watt	ea.
5	50	$1.24	378	150	$2.74
5	150	2.74	400	25	.98
6	25	.98	500	25	.98
6	50	1.24	500	75	1.97
7	25	.98	585	150	2.74
7.5	100	2.25	750	25	.98
8	50	1.24	750	150	2.74
10	25	.98	1000	25	.98
12	25	.98	1200	225	3.25
15	25	.98	1250	50	1.24
16	50	1.24	1250	150	2.74
22	50	1.24	1500	50	1.24
25	25	.98	2000	25	.98
50	25	.98	2000	50	1.24
50	50	1.24	2500	100	2.25
60	25	.98	3000	25	.98
75	150	2.74	3000	100	2.25
80	50	1.24	3500	50	1.24
80	500	4.95	5000	25	.98
100	50	1.24	5000	50	1.24
125	25	.98	7500	50	1.24
150	50	1.24	7500	100	2.25
200	25	.98	10000	50	1.24
250	25	.98	10000	100	2.25
350	25	.98	20000	150	2.74

(Discounts to Quantity Users.)

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LARGE VARIETY AVAILABLE AT GREAT SAVINGS

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MPJ	Non-Ind. 5 W., 330, 6000, 20K, 25K, Ohm	$ .65
MPA	" " 20 W., 26 Meg	1.95
MPO	" " 35, 1 Meg	2.95
MPR	" " 100 W., 32K Ohm	7.90

MVP IND. 10 W. Max. 10KV Cont.

25 Meg. 1 Meg. 7.5 Meg.
4 " 2.5 " 10 "
5 " 5 " 20 "
7.5 " 6 " 25 "
8 " *7 " 50 "

$1.28 ea.

*Lugs

MVA IND. 20 W. Max. 25KV Cont.

75K 3 Meg.
.5 Meg. 6 Meg
1 " 7.5 "

$1.85 ea.

MVO IND. 35 W. Max. 50KV Cont.

2 Meg. 20 Meg.
3 " 50 "
15 "

$2.95 ea.

OIL CONDENSERS - STD. BRANDS

3	MF	1000	V.D.C.	$ .79
4	"	"	"	.95
8	"	"	"	1.89
2	"	2500	"	2.95
.25	"	3000	"	1.75
2	"	"	"	3.95
1	"	4000	"	3.55
2	"	5000	"	6.75
.03-.03		6000	"	1.50
1-1		7000	"	1.65
.125	.35 KV			19.75
2	MF	330	V.A.C.	.65
4	"	"	"	1.29
20	"	"	"	3.95
25	"	"	"	4.75
30	"	"	"	5.55
15	"	440	"	4.25
28	"	"	"	6.95
4	"	660	"	2.75
5	"	"	"	2.95
6	"	"	"	3.19
8	"	"	"	3.45

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POWER SUPPLIES
0-15000 V—.5 amp DC output—115 AC input.....$395.00
0-15000 V—.035 amp DC output—115AC input.....$215.00
CO-AX—CABLE—RG-38-U—FLEXIBLE 55 OHMS.....10c Ft.

RADAR—SA—SC—SG—SN—SO—SCR 296—SCR 545—SCR 533—T-2—RC—188 I.F.F.—COMPONENTS AND UNITS. TEST SETS—OAK—LZ—SL—OAP—545 OSCILLATOR—3CM—WAVE & WATT METER.

SONAR—QBD—QBF—NJ—components & equipment.

AMPLIFIERS—400 Watt audio output—115 AC 60 cycle Input ideal for 400 cycle test work.....$125.00

CIRCUIT BREAKERS—120 V AC—20-AMPS—H.C.B. Co.....1.00

RHEOSTATS—50 watt—22—80 or 125 OHMS—Ceramic.....1.00

CONDENSERS—D-168574—16MFD—400V—CO—EF—50-+85° C.....7.50

TEST CORD—ES-718593-WE Connectors.....2.50

NETWORKS—D162693—D164855—D162769—D162770—T48149 and dozens of other types.

TRANSFORMER—Commutator type-input-115V-50/60 cycle 1 phase-output 3x90V @3AMP. type KS-15059Lol.....$35.00

TRANSFORMER—110V input—7500V output ½KW—Sealed.....17.50

MC-363 A Range converter (Mickey Mouse) less tubes.....85.00

INSULATORS—8" long—ceramic & Bronze Standoff.....1.25

TRANSFORMERS—5 KW—220/5500V Bridge Type.....85.00

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SURPLUS Laboratory Equipment

GENERAL RADIO
107-M Variable Inductor.....$35.00
516D Het. Freq. Meter
726A, 727A VTVM
775-A Frequency Limit Monitor (1.6 to 45 Mc).....$125.00

FERRIS
16-C Std. Signal Generator 50 Kc to 28 Mc
33A Crystal Calibrator
34-A U.H.F. Crystal Calibrator.....$149.00
18-C V.H.F. Signal Generator

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RA-90A H.V. Power Supplies, New +-4900-1000V; Input 110V 400 CPS.....$15.00
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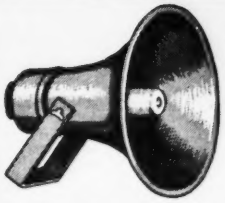

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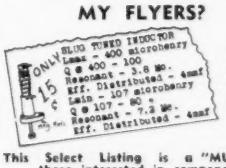

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UNIVERSAL WINDING MACHINE

Model No. 104 with all accessories. State price and condition.

SOUTHWESTERN INDUSTRIAL ELECTRONIC CO.
P. O. Box 13058, Houston 19, Texas

WANTED
WESTERN ELECTRIC VACUUM TUBES

Types 101F, 102F, 272A, 274A or B, 310A or B, 311A, 313C, 323A, 328A, 329A, 348A, 349A, 352A, 373A, 374A, 393A, 394A, 121A Ballast Lamps.

W-6641, Electronics
330 West 42nd St., New York 18, N. Y.

WANTED
TEST EQUIPMENT

of high quality: state asking price, age and condition in first letter.

W-1150, Electronics
330 W. 42nd St., New York 18, N. Y.

WILL BUY
All Types Aircraft Bulbs
24V - 28V -
WRITE
H. FINNEGAN
49-57 Washington Ave., Little Ferry, N. J.

Don't forget the
BOX NUMBER

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Quick ANSWERS to your business problems . . .

HUNDREDS of miscellaneous business problems can be quickly and easily solved through the use of the Searchlight Section of this or other McGraw-Hill publications.

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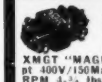
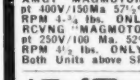


6 VOLT DYNAMOTORS
CARTER "MAGMOTORS"
Perm Magnets. Extremely Hi-Eff. Compact 3¼x3-¾x2½". Lo-TempRise.
XMGT "MAGMOTOR" Inst 5.5 VDC: Output 400V/150Ma 57½% Eff. 6500 RPM 4-¾ lbs. ONLY **$8.98**
RCVNG "MAGMOTOR" Inst 6 VDC: Output 250V/100 Ma. 52% Eff. 3800 RPM 4½ lbs. ONLY **$4.98**
Both Units above SPECIAL $12.49



MICA RCVNG & XMITTING CAPACITORS
Brand New! Famous Mfrs Rigid Specs.

Mfd. TypeA (*SilverMica)	WVDC	Each
.000015*	500	$.09
.00002	500	.04
.000022	500	.04
.000024*	500	.09
.000025*	500	.09
.00004	500	.04
.00005*	500	.09
.000082	500	.04
.0001	500	.04
.0001*	500	.09
.0002	500	.04
.0002*	500	.09
.0003	500	.04
.00042	500	.04
.00047	500	.04
.001	500	.04
.001*	500	.09
.0011	500	.04
.0011*	500	.09
.0012*	500	.18
.002	500	.06
.00224*	500	.18
.0025	500	.18
.003	1000	.20
.003	500	.10
.0033*	400	.25
.004	500	.10
.004*	500	.25
.005	500	.10
.006	500	.10
.01	500	.08
.01	500	.15
.01	600	.17

Type B or Similar		
.001	500	.04
.002	500	.10
.01	500	.15

Types C and D		
Fig. Mfd.	Wv	Each
C .0001	600	.20
D .0004	2500	.35
C .00047	2500	.35
D .00055	600	.30
D .00082	2500	.35
D .00085	600	.20
C .001	600	.20
D .001	1200	.30
D .0012	600	.20
C .002	600	.25
CD.002	1200	.30
D .0022	2500	.75
D .0022	2500	.75
CD.003	600	.25
C .003	1200	.35
D .0035	2500	.75
D .0036	2500	.75
C .004	600	.27
C .004	1200	.40
D .0043	2500	.95
CD.005	600	.27

Fig. Mfd.	WVDC	Each
C .005	1200	.40
D .005	2500	.75
D .005	3000	1.25
D .0051	1200	.35
C .006	600	.25
D .006	2500	.98
D .0062	1200	.45
D .0068	1200	.45
C .008	600	.25
C .01	600	.30
CD.01	1200	.50
D .01	2500	1.25
D .013	1200	.65
D .015	600	.35
D .015	2500	1.50
CD.02	600	.45
CD.03	600	.98
D .03	1200	1.45
D .033	600	.98
D .033	1200	1.90
D .039	600	1.60
D .04	600	1.65
D .05	600	1.90
Mfd.	WV	Each
.00003	3500	.65
.00005	3000	.65
.00009	5000	.75
.0001	5000	.90
.0001	6000	3.49
.00015	5000	1.89
.0004	3000	.85
.0006	6000	3.49
.0007	3000	.90
.0015	5000	1.95
.0025	2500	.90
.003	2000	.90
.005	5000	2.49
.006	2000	.81
.006	2500	1.35

Type F or Similar		
.000033	3500	.95
.0003	8000	3.00
.0005	8000	3.00
.0006	8000	3.00
.001	10000	4.15
.001	8000	3.95
.0012	8000	3.95
.0015	8000	3.95
.002	8000	4.25
.0025	8000	4.25
.002	3000	3.65
.006	5000	1.85
.41	600	3.95
.01	5000	9.95

Type G		
.0003	10000	4.75
.005	5000	4.75
.04	1000	4.75
.09	1500	9.95
.0006	6000	4.95
.00025	10000	8.95

Oil Condensers—Famous Makes

VWDC	Mfd	Each
50	4	29¢
300	1.2	15¢
300	1	13¢
400	2	25¢
400	4	44¢
400	6	69¢
400	10	79¢
400	2x.1	10¢
400	3x.25	18¢
500	.1	10¢
500	1	15¢
500	4	55¢
600	.1	23¢
600	.2	25¢
600	.25	32¢
600	.5	32¢
600	1	35¢
600	2	40¢
600	4	65¢
600	5	79¢
600	7	98¢
600	10	$1.15
600	2x.05	9¢
600	2x.25	20¢
600	2x2	55¢
600	3x.05	12¢
600	3x.22	22¢
600	3x.25	50¢
600	3x8	2.98
600	4	79¢
1000	.1	39¢
1000	1	45¢
1000	5	98¢
1500	.025	59¢
1500	.05	39¢
1500	2x.1	79¢
1500	.5	98¢
1500	5	2.49
1500	6	2.69
2000	.1	89¢
2000	1	1.27
2000	2	1.98
2000	3	3.49

VWDC	Mfd	Each
2000	4	3.98
2000	5	4.98
2000	8	8.98
2500	.25	74¢
3000	.1	1.00
3000	.5	2.49
3000	2	3.98
3000	4	5.95
3600	1	3.25
4000	.05	1.89
4000	1	3.75
5000	.2	2.25
5000	2	9.98
5000	4	16.00
5500	2	10.98
6000	2	12.98
7000	.002	.98
7000	.0075	1.29
7500	.03	1.98
7500	.1	2.89
7500	1	7.98
12500	.65	14.89
12500	2	19.98
15000	.0016	4.98
25000	.00025	4.95
25000	1	95.00

VAC	Mfd	Each
220	4	55¢
220	5	90¢
225	3.3	49¢
330	1.25	55¢
330	.5	69¢
330	1.75	65¢
330	2	65¢
330	2.5	75¢
330	2.8	98¢
330	3	85¢
330	4	87¢
330	5	$1.00
440	1.5	98¢
660	5	3.75
660	6	3.95

Super Wide-Range High Fidelity Amplifier Kit
20 to 20,000 cycles. 10 Watts. Max. Harmonic Distortion 1¾% at Full Output; only 0.5% at 5 Watt output. Works with ANY Mike, Pickup or RCVR. All-Electronic stage for use with GE/Pickering, etc. VarReluc Magnetic&Xtal Pickups & Mike. Separate Electronic Bass & Hi-Freq Tone Boost Tube Ckts. Self-balancing Cath Foll. Phase Inv. 2A3/6B4G PP, 4 other stages Plus All Pwr & partly Built-Up RCA Chassis. Less Output Xfmr. SPECIAL **$24.95**
10 Watt Hi-Fi Kit—20to20000cps. Self-balancing, Cath Foll, Perfect Response, Phase Inv 2A3/6B4GPPoutput. All parts, data, less Outpt Xfmr. Incl. RCA Chassis **$14.95**

XTRA SPECIAL—New TV Parts

Width Control Sim 201R4 ..... 39¢
Focus Coil Sim 202D2 ..... $4.98
HV-Horiz&Defl Outpt Sim 21T5&ckt Data 2.49
UTAH9318HBO Xfmr H'Sld ..... 89¢
UTC 58662 V80XXfmr H'Sld ..... 89¢
TV Yoke SPECIAL $2.49
Focus Coil Magn Kinescps. $2.98
HiV Cndsr 500mmf/10KV ..... 39¢
HiVolt Cndsr 500mmf/20KV ..... 69¢
Ion Trap Magnet RCA203DI ..... 98¢
RCA HiV DeflXfmr21T1 ..... $4.98
V'OutpfXfmrSimRCA204T2 ..... $2.69
12" Kinescope Glareless Mask. Yellow ..... 59¢
TWINEX TV 300ohmCable 100ft $1.10
TV TWINEX TACKER $2.98
5000HvyDtyStaplesBoxed $2.98

CRYSTAL DIODES THERMISTORS—VARISTOR

Type	Each 10For	Each 100For
IN21	.50	$4.00
IN21A	1.00	8.50
IN21B	1.75	14.98
IN22	1.50	14.00
IN23	1.50	14.00
IN23A	1.50	14.00
IN23B	3.00	27.50
IN26	3.00	27.50
IN27	1.75	14.98
IN34	.84	7.98
IN35	2.79	25.98
IN43	1.25	10.00
IN44	.85	7.50
IN45	1.25	8.39
IN48	1.15	10.49
IN51	1.08	9.49

D167019 VolLimitr $2.95
D168391 ThermComp ..... .90
D168392 ThermComp 2.00
D170396 HF PwrMeas ..... .90
1C Built Time Delay ..... .90
CW20259 VaristorS8C 2.95
Xtal Freq Standards:
200 Kc 3.98
500 Kc 3.98
1000 Kc FT243 Mtd 2.95
4700 Kc ..... .98
5000 Kc 3.98
Crystals—Mtd Htr Ovens
Highest Accy & Stability
5010,5025,5055Kc,Ea$14.98
Xtal Heater Oven—Bargain
Takes Any FT243 Xtal
"TAB" Special ..... 98¢

Beckman pH Meter Foundation

Industrial Type Removed from Precision Equip for INSTANT measurement of pH. With UltraSens meter (SIMPSON 29 or equiv). Includes BECKMAN Helipot. For Battery Operation. Less Case & Access. Good Usable Cond. Orig. Equip. List Over $175. SPECIAL $19.95

Basic Photoflash Kit
Complete Pwr Supply with cndsrs, lamp, data, etc. for 6V,AC $25.95
Studio Kit Air Corps 1169 set, 115VAC or Batt w/2lamp $53.95
1169AirC Flash Pwr Pack NEW,inclData $19.95
FlashCndsrs-7mfd/2500vdc/21.9W-Sec ... $2.75;
5/12.50,15mf/330vac/1800dc Inter 3-49, 25mf/330vac/1800dc Inter 3-49, 15mf/600vac/2800dc Inter $5.98 16mmPAN500fimGSAPcamera, 54 rolls $5.49
Hi-V P'Flash Pwr Kit Ident 1800V Dbir Ckt: 115VACinpt; Outpt-900V/35ma & 2x2.5V,2AeaWndg/4KVinsSigCspee. H'sld PLUS 2x25mfd/90Watt-Sec Flash Cndsrs&. Data for Flash $17.95
W Flash Lamp $26.98
"SUNFLASH" SPECIAL! 100to300W-Sec Inpt Non-Darkening,ShockMtd, 100000 Flashes 4-prg IntChngble 5804X Data ... $10.98
SylvaniaR4330 12millionlumens,100W-Sec $14.98
X-400 Air Corps Lamp $11.98

Sig Corps Dry Batteries—Gtd
Brand New Shelf Dated—Tested

BA 34 7½/6/4½/3/1"NeoV ..... 39¢
BA 35 1½VsimBURG 4FH ..... 39¢
BA 36 45, 22½V BURG5308 ..... 89¢
BA 37 1½V Walky-Talky ..... 29¢
BA 38 103½V Walky-Talky $1.49
BA 39 150/7½VBURGFSA100 ..... 1.69
BA 40 90/1½VBurg4GB60 ..... 1.19
BA 41 60/25½/1½V ..... 89¢
BA 43 90/45/1½V ..... 98¢
BA 51 67½V MiniMax ..... 89¢
BA 70 90/60/4½V $2.50
BA205U 3V Burg F2BP...8 for $1.00
WESTON STANDARD CELL 1.0194 Volts Average UnMtd $5.98

PRECISION RESISTORS—Over 2,500,000 In Stock
"TAB"—Specialists in Precision Resistors
0.1 Accuracy Up To 0.1 Percent—We Ship Types in Stock

0.1	74	330	693	1800	2400	5770	14000	31500
0.116	75	340	697	1818	2450	5910	14250	32000
0.42	80	350	699	1830	2463	6000	14400	33000
0.425	81.4	360	700	1845	2475	6100	14500	35000
0.667	93	366.6	711	1852	2490	6125	14550	37000
0.7	89.8	370	733	1894	2500	6140	14600	38140
1.03	90	375	740	1895	2525	6200	15000	38500
1.3	95	380	750	1896	2600	6300	16000	39000
1.75	100	389	800	1897	2625	6495	16500	39500
2.5	101	390	805	1898	2635	6500	16800	40000
3	105	400	850	1899	2700	6840	17000	42000
3.83	105.7	410	854	1900	2750	6990	17500	43000
3.95	107	414.3	899	1901	2850	7000	17977	45000
1	120	418.8	900	1902	2860	7220	18000	47000
4.35	121.2	425	910	1903	2870	7300	18300	47500
5	125	426.9	917	1904	2900	7700	18380	48000
5.025	130	427	946	1905	3000	7717	18500	48660
6.25	135	440	978	1906	3100	7900	18900	49000
6.5	140	450	1000	1907	3163	7930	19000	50000
7	147.5	452	1030	1908	3259	7950	19500	52000
7.8	150	460	1056	1909	3290	8000	20000	55000
7.9	160	470	1067	1910	3333	8094	20441	56000
8	165	475	1100	1911	3384	8250	20500	57065
10.38	170	478	1110	1912	3500	8500	21000	58333
11.25	175	480	1150	1913	3509	8700	21500	60000
12	179	487	1155	1914	3700	8770	22000	61430
13.52	182	500	1162	1915	3730	9000	22500	62000
14.2	182.4	518	1175	1916	3760	9100	22990	64000
14.25	200	520	1200	1917	4000	9445	23000	65000
14.5	209.4	525	1225	1918	4030	9500	23150	66600
15	216	540	1250	1919	4200	9710	23325	66650
16	220	550	1260	1920	4220	9800	23400	67500
17	220.4	575	1300	1922	4280	9900	23500	68000
19	225	580	1322	1924	4300	9902	24000	70000
20	230	588	1350	1926	4514	10000	24600	72000
22	235	600	1355	1960	4440	10430	25000	73500
23	240	612	1400	1980	4444	10500	25200	75000
25	245	625	1488	2000	4500	10600	25400	80000
26	245.4	633	1495	2045	4720	10900	25833	82000
28	250	640	1500	2080	4750	10936	26000	84000
30	260	641	1510	2095	4850	11000	26500	85000
31.5	271	645	1518	2141	4885	11400	26600	85750
37	275	649	1600	2142	4900	11500	27000	88000
48	280	650	1640	2145	5000	11690	27500	90000
49	286	657	1650	2150	5100	12000	28000	91000
50	289	665	1650	2160	5210	12500	28430	93500
51.78	299	670	1670	2180	5235	12600	28500	95000
55	300	672	1680	2187	5270	13000	29000	
56.7	310	675	1710	2195	5300	13100	29500	
60	311.5	680	1712	2200	5500	13500	29990	
63	320	681	1740	2250	5600	13550	30000	
68	325	684	1770	2300	5730	13600	31000	

Any Size Above, Each ..... 25¢; Ten for $1.98

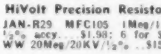
100000	150000	190000	238000	314000	420000	550000	761300	
110000	155000	198000	240000	316000	422000	570000	800000	
115000	160000	200000	245000	325000	425000	575000	813050	
116667	165000	201000	250000	330000	450000	600000	850000	
120000	166750	205000	265000	330000	458000	620000	900000	
125000	167000	210000	268000	333500	470000	650000	930000	
130000	169200	213000	270000	350000	475000	654000	950000	
135000	175000	220000	275000	353500	500000	660000		
140000	180000	225000	294000	375000	520000	680000		
141000	185000	229000	300000	385000	521000	700000		
145000	185000	230000	307500	400000	525000	716300		
147000	186600	235500	311000	402000	543000	750000		

Any Size Above, Each ..... 35¢; Ten for $2.98

Megohms								
1	1.39	1.75	2.5	3.5	4.5	6.6	8.02	12.83
1.1	1.4	1.8	2.7	3.673	4.7	6.7	8.5	13.
1.2	1.5	1.9	2.75	3.75	5	7	9.05	13.85
1.25	1.57	2	2.8	3.9	5.5	7.5	9.5	15
1.3	1.579	2.11	2.855	4	6	7.62	10	20
1.35	1.6	2.2	3	4.23	6.3	7.74	11.55	

Any Size Above, Each ..... 70¢; Ten for $5.98

Vacuum Precision HiVolt Resistors



Megohms—12/.25/6/.75/.83/.99
/1, 1.5/2/3/3.75 ½% accy
Ea. $1: ..... 10/$7.50

HiVolt Precision Resistors

JAN-R29 MFC105 1Meg/1KV
1% accy $1.98; 6 for $10.
WW 20Meg/20KV/½% .. $15.95

HiVolt HiFreq Resistors

MVT 2 or 2½Meg/5W/7.5 KV wkg Ea. .. $1.08; 10 for $8.98
MVP 5, 7, or10Meg/10W/10KV wkg Ea. ..... $1.49; 8 for $10
12Meg/10W/10KVwkg600 $1.49;
MVZ 30Meg/20W/25KV wkg Ea. ..... $1.98; 6 for $10.
MVE 50Meg/20W/40KV wkg Ea. ..... $1.98; 6 for $10

DAVEN ATTENUATORS
Brand New

5000ohms/20pos $1.98
5000ohms/30pos. 2.49
"TEE" Dual 5000 ohms/20 pos.. 2.98
IRC 100,000ohms/20 pos 1.98
IRC 250,000ohms/20pos ... 2.49
Rheostat 20ohm/50Watt w/knob & Dial Plate ..... 69¢
Rheostats 25Watt 1RCA50hmite
Slotted Shaft 350, 500, 1500, 5000 ohms 3 for..... 98¢

MERCURY THERMO-REGULATOR
Instant Action, Dual Circuit 32,105°F RESEARCH, TEMP CONTROL, FIRE PREV. 4½". Write for Data List #20. Only 98¢; 12/$10.

ROTARY SWITCHES

Decks	Ckts	Pos	Each
1	1	2	15¢
1	1	3	18¢
1	1	4	19¢
1	1	6	27¢
1	1	21	36¢
1	2	2	19¢
1	2	4	27¢
1	2	5	30¢
1	3	2	21¢
1	3	3	25¢
1	4	2	25¢
1	2	1	19¢
2	1	4	38¢
2	1	5	35¢
2	1	7	39¢
2	2	3	45¢
2	2	5	49¢
2	4	2	45¢
2	4	11	55¢
3	2	4	39¢
3	3	3	49¢
4	1	6	59¢
4	1	7	63¢
6	2	5	79¢

Steatite Sections—

	HiV & RF		
1	1	6	69¢
1	2	2	49¢
2	2	3	79¢
2	2	4	89¢
2	2	5	95¢
2	3	3	98¢
3	3	3	99¢
5	3	3	$1.25
5	1	6	1.05
6	2	6	1.49

Full Wave Bridge Rectifiers

In	Out	Amps	Each
14V	14V	3.5	$3.98
18	14	5	4.98
36	28	3.5	4.98
36	28	5	8.49
135	115	3.5	19.49

Full-Wave Bridge Sel Rect for Relays or Pwr Inst 115to130 VAC: Outpt 115VDC/40ma. Ea. 49c 10/4.49

TAB MONEY BACK GUARANTEE! $3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO 2-7230
THAT'S A BUY "TAB" THAT'S A BUY
DEPT. 11E SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200
TAB MONEY BACK GUARANTEE $3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO 2-7230

★★★ SPECIALS ★★★

SNOOPERSCOPE INFRARED
Image-Converter Tube HiSensitivity simplified design 2" dia., Willemite screen—Resolution up to 350 lines/in. Complete data & Tube, "TAB" SPECIAL **$7.90**
2 for **$14.50**
Write for quantity prices

866A Kit. 2Tubes&Xfmr 115v60cyc Inpt: Output: 2.5vct/10A/10 KVins PLUS sckts **$5.95**

872A Kit TubesSckts & Xfmr ..... 12KVins $12.95

Write for Your FREE "Tabogram"

BLOWERS
Cool That Tube!

40 CFM 28vacdc $3.49
70CFM 115V400cyUSN 4.49
100 CFM 28vacdc 4.95
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OA3 VR75	$.98	2A7	1.05	4J47	45.00	6K5GT	.86	12A8GT	.56	50B5	.54
OA4	1.05	2B4	.98	4T4 2	9.95	6K6GT	.45	12AH7GT	.84	80CS	.89
OB2	.85	5C22	47.00	5BP1	9.95	6K7G	.55	12AT6	.45	80L6GT	.86
OB3 VR90	.67	2B22 GL559	.73	5C30 C5B	9.95	6K8	.86	12AT7	.79	83A	.89
OC3 VR105	.75	2C21 1642	.81	5D21	25.95	6L5G	.98	12AU6	.59	87	.47
OD3 VR150	.49	2C22 7193	.18	5J23	14.25	6L6	.98	12AU7	.69	RK65	22.98
OZ4	.87	2C26	.25	5J29	17.39	6L7	.83	12AV6	.49	RK67	12.75
C1A	9.95	2C34 RK34	.55	5J30	49.27	6N7GT	.90	12AX7	.89	RK68	2.29
O1A	.45	2C39	18.00	5R4GY	1.12	6P5G	.81	12BA6	.56	70L7GT	1.15
1A3	.59	2C40	3.75	5T4	.96	6Q7	.83	12BE6	.45	71	.65
1A4	1.26	2C43 464A	8.91	5U4G	.52	6R7G	1.05	12BH6	.45	72	.95
1A5GT	.78	2C44	1.69	5V4	.95	6S7G	.81	12C8	.55	CRD72	1.85
1A6	1.26	2C51	10.98	5W4	.87	6S8GT	.79	12L8GT	1.89	CRP72	1.37
1A7GT	.69	2D21	.90	5X4G	.71	6SA7GT	.45	12J5GT	.75	73	1.67
1B3 8016	.81	2E5	.98	5Y3GT	.38	6SB7Y	.81	12J7GT	.78	NR74	.29
1B21 471A	2.95	2E22	1.34	5Z3	.81	6SC7	.65	12K7GT	.78	75	.56
1B22	4.50	2E24	2.98	5Z4	.88	6SD7GT	.45	12K8	.55	76	.45
1B23	9.00	2E25 HY65	2.98	C6A	8.35	6SF5	.55	12N7GT	.55	FG81A	4.45
1B24	4.85	2J21	11.98	6A3	.98	6SF7	.78	12SH7	.34	82	.85
1B26	4.50	2J21A	11.98	6A4	1.29	6SG7	.63	12SJ7GT	.58	83	.89
1B27	4.75	2J22	29.95	6A6	1.02	6SH7	.58	12SK7GT	.55	83V	1.05
1B29	3.39	2J25	98.00	6A7	.75	6SJ7GT	.55	12SL7GT	.63	84 6Z4	.57
1B32	3.24	2J26	8.89	6AB7 1853	.84	6SK7GT	.45	12SN7GT	.54	85	.57
1B37	45.00	2J27	14.50	6AC5	1.05	6SL7GT	.55	12SQ7GT	.54	89	.36
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1B40	29.95	2J32	39.95	6AD6	.81	6SN7WGT	.89	12X3	.90	FG104	14.98
1B41	49.95	2J33	14.50	6AD7	1.17	6SR7GT	.47	12Z3	.72	FG105	10.75
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1C7G	1.27	2J49	24.00	6AK6	.81	6V6G	.54	21	1.49	FG117A	16.95
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1E5	1.38	2J53	40.00	6AL7	1.00	6W7G	.87	20	1.17	2.45	730A
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1LE3GT	.96	3B24	1.85	6BG6G	1.49	7B7	.60	30	.36	250TH	24.98
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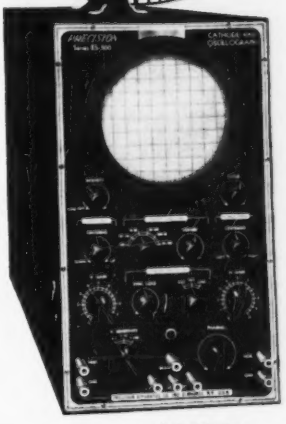

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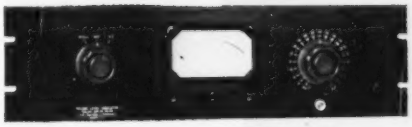

Type 915
Rack model, terminating and bridging type. Meter multiplier ranges: Terminating, −6 VU to +32 VU; bridging +4 VU to +42 VU; or terminating, −6 VU to +16 VU; bridging, +4 VU to +26 VU. 2 VU steps. Reference level: 1 mv into 600 ohms

Type 910
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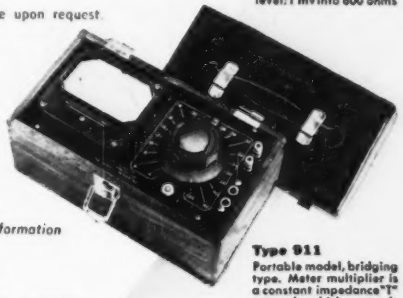

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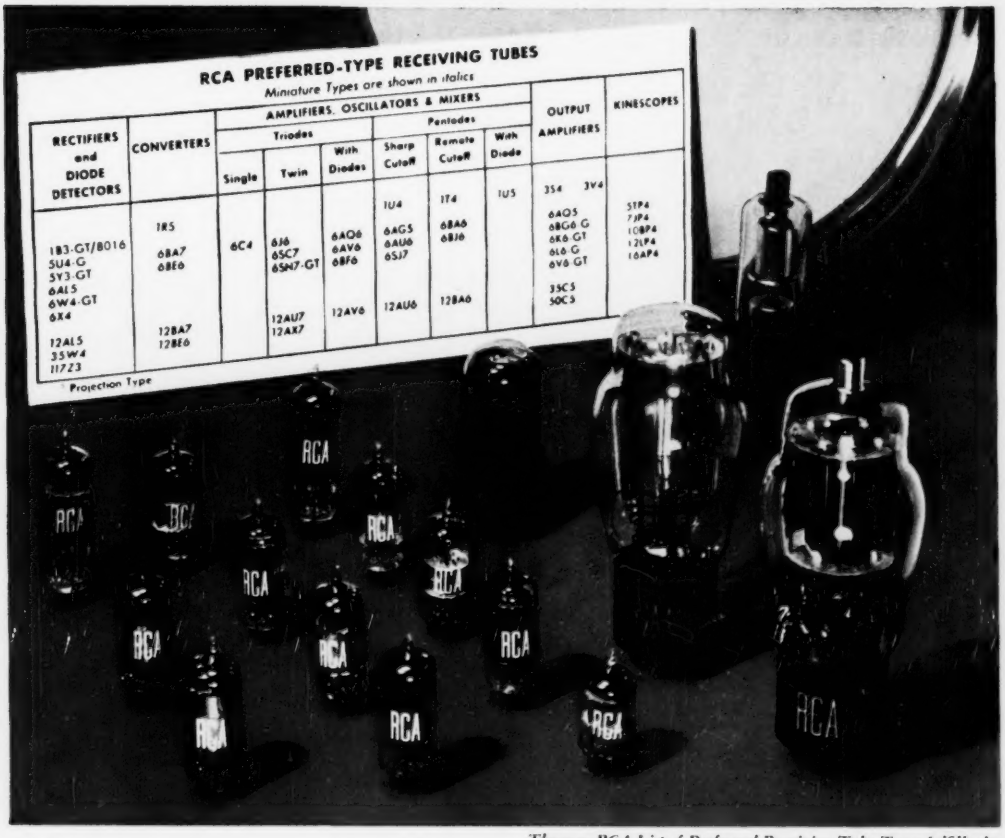

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